SERIAL 230200-C INTELLIGENT TRANSPORTATION SYSTEM (ITS) DEVICES AND COMMUNICATION EQUIPMENT

DATE OF LAST REVISION: October 12, 2023 CONTRACT END DATE: October 31, 2024

CONTRACT PERIOD THROUGH OCTOBER 31, 2024

TO: All Departments

FROM: Office of Procurement Services

SUBJECT: Contract for **INTELLIGENT TRANSPORTATION SYSTEM (ITS) DEVICES AND COMMUNICATION EQUIPMENT**

Attached to this letter is published an effective purchasing contract for products and/or services to be supplied to Maricopa County activities as awarded by Maricopa County on **October 12, 2023 (Eff. 11/01/2023).**

All purchases of products and/or services listed on the attached pages of this letter are to be obtained from the vendor holding the contract. Individuals are responsible to the vendor for purchases made outside of contracts. The contract period is indicated above.

Kevin Tyne, Chief Procurement Officer
Office of Procurement Services

LN/mm
Attach

Copy to: Office of Procurement Services
David Lucas, MCDOT

(Please remove Serial 180252-C from your contract notebooks)

ENTERPRISE NETWORKS SOLUTIONS INC, 3633 N. 55TH PL, MESA AZ 85215

COMPANY NAME:	Enterprise Networks Solutions
DOING BUSINESS AS (dba):	ENS
MAILING ADDRESS:	3633 N. 55th Place
REMIT TO ADDRESS:	3633 N. 55th Place
TELEPHONE NUMBER:	4805051111
FAX NUMBER:	4805051112
WWW ADDRESS:	www.ens-az.com
REPRESENTATIVE NAME:	Jeff Bunker
REPRESENTATIVE TELEPHONE NUMBER:	480-505-1111
REPRESENTATIVE EMAIL ADDRESS	jbunker@ens-az.com

	YES	NO	REBATE
WILL ALLOW OTHER GOVERNMENTAL ENTITIES TO PURCHASE FROM THIS CONTRACT:	☑	☐	
WILL ACCEPT PROCUREMENT CARD FOR PAYMENT:	☑	☐	

☑ NET 30 DAYS

BLANKET LABOR RATES				
Title	**Unit Price**	**Qty**	**UofM**	**Bidder Notes**
Senior Systems Engineer	$185.00	1	hour	Hourly rate

ATTACHMENT D 1- SUPPLEMENT CATALOG PRICING

Spec #	ITEM DESCRIPTION	% DISCOUNT FROM CATALOG *Note, all catalog pricing is subject to price increases*
2.1.3	**CLOSED CIRCUIT TELEVISION**	
	LIST ADDITIONAL MFG NOT NOTED	
2.1.3.1.1.1 to 2.1.3.1.7	Camera Assembly, Camera and Lens, Pan/Tilt Unit, Precision Pan/Tilt Units, Enviornmental Enclosure, Cylindrical Enclosure, Dome enclosure, Mounting	
	Axis	23%
	Verkada	36%
2.1.4	**RADIO COMMUNICATION EQUIPMENT**	
	LIST ANY OTHER MFG NOT NOTED	
2.1.4.1.1.1 To 2.1.4.1.5	Wireless Ethernet Transceivers, (A) Functional requirements, (B) Physical Requirements, (C) Transceiver, (D) External System Antenna, (E)Cables	
	Aruba Networks (Price list as of 8/1/2023)	44%
	CradlePoint (Price list as of 8/1/2023)	18%
	Arista (Price list as of 8/1/2023)	37%
	Palo Alto (Price list as of 8/1/2023)	25%

ENTERPRISE NETWORKS SOLUTIONS INC

	RuggedCom (Price list as of 8/1/2023)	15%
	Ruckus (Price list as of 8/1/2023)	45%
	Extreme Networks (Price list as of 8/1/2023)	41%
	Juniper Networks (Price list as of 8/1/2023)	50%
	FiberStore (see website for catalog https://www.fs.com/)	10%
	Fortinet (Price list as of 8/1/2023)	35%
2.1.5	**ADAPTIVE SIGNAL CONTROL TECHNOLOGY (ASCT) EQUIPMENT**	
2.1.5.1.1 to 2.1.5.8.2	(A) Multifunction T1 Router, 2.1.5.1.2 (B) Field Hardened Network Gateway Router (FHNGR) with four port T1 Multiplexer, and Field Hardened Ethernet Backbone Switch (FHEBS) / Field Hardened Ethernet Access Switch (FHEAS), 2.1.5.1.3 (C) Layer 3 Router, T1 Multiplexer, and Ethernet Switch	
	Aruba Networks (Price list as of 8/1/2023)	44%
	CradlePoint (Price list as of 8/1/2023)	18%
	Arista (Price list as of 8/1/2023)	37%
	Palo Alto (Price list as of 8/1/2023)	25%
	RuggedCom (Price list as of 8/1/2023)	15%
	EtherWan (Price list as of 8/1/2023)	20%
	Ruckus (Price list as of 8/1/2023)	45%
	Extreme Networks (Price list as of 8/1/2023)	41%
	Juniper Networks (Price list as of 8/1/2023)	50%
	Fortinet (Price list as of 8/1/2023)	35%
2.1.6	**BLANKET LABOR RATES : Senior Systems Engineer**	**Per Hour**
	Services - Engineer Level 1 - Basic rack and stack experience with limited field experience	$55
	Services - Engineer Level 2 - Working Engineer with field experience but limited unsupervised.	$150
	Services - Engineer Level 3 - Working Engineer with good field experience. Can do most tasks without supervision.	$185
	Services - Engineer Level 4 - Senior Engineer with multiple years experience. Can perform all tasks without direction or supervision.	$225
	Services - Engineer Level 5 - Principle Architect: Senior Engineer or Manager with 10+ years experience. Typically oversees projects and is responsible for the more complex solutions.	$295

PRICING SHEET: NIGP CODE 28595, 83829, 93649 and 99240

Terms:	NET 30 DAYS
Vendor Number	VC0000008704
Certificates of Insurance	Required
Contract Period:	To cover the period ending **October 31, 2024.**

ATTACHMENT B

AGREEMENT PAGE

Respondent hereby certifies that Respondent has read, understands and agrees that acceptance by Maricopa County of the Respondent's Offer will create a binding Contract. Respondent agrees to fully comply with all terms and conditions as set forth in the Maricopa County Procurement Code, and amendments thereto, together with the specifications and other documentary forms herewith made a part of this specific procurement.

BY SIGNING THIS PAGE THE SUBMITTING RESPONDENT CERTIFIES THAT RESPONDENT HAS REVIEWED THE ADMINISTRATIVE INFORMATION AND STANDARD CONTRACT'S TERMS AND CONDITIONS LOCATED AT (https://www.maricopa.gov/DocumentCenter/View/6453) AND AGREE TO BE CONTRACTUALLY BOUND TO THEM.

X Small Business Enterprise (SBE)

Enterprise Networks Solutions Inc. — RESPONDENT (FIRM) SUBMITTING PROPOSAL

86-1026279 — FEDERAL TAX ID NUMBER

021558106 — DUNS #

Larry Potthoff President & CEO — PRINTED NAME AND TITLE

AUTHORIZED SIGNATURE

3633 N. 55th Place — ADDRESS

480-505-1111 — TELEPHONE

FAX #

Mesa — CITY

AZ — STATE

85215 — ZIP

8/22/2023 — DATE

WEB SITE: www.ens-az.com

EMAIL ADDRESS: larry@ens-az.com

MARICOPA COUNTY, ARIZONA

BY: Kevin Tyne
CHIEF PROCUREMENT OFFICER,
OFFICE OF PROCUREMENT SERVICES

November 6, 2023
DATE

APPROVED AS TO FORM:

DEPUTY COUNTY ATTORNEY

11/06/2023
DATE

INTELLIGENT TRANSPORTATION SYSTEM (ITS) DEVICES AND COMMUNICATION EQUIPMENT

1.0 INTENT

The intent of this Invitation for Bid (IFB) is to establish a source/sources for the purpose of obtaining Electrical Conductors, Fiber Optic Cable and Equipment, Closed Circuit Television, Radio Communications Equipment, Cellular Routers, Adaptive Signal Control Technology (ASCT) Equipment, Traffic Data Collection Equipment, Connected Vehicle Equipment and Intelligent Transportation System (ITS) Network Equipment to be used by the Maricopa County Department of Transportation (MCDOT).

1.1 Other governmental entities under agreement with Maricopa County (County) may have access to services provided hereunder (see also Sections 3.25 and 3.26 below).

1.2 The County reserves the right to add additional contractors, at the County's sole discretion, in cases where the currently listed contractors are of an insufficient number or skill set to satisfy the County's needs or to ensure adequate competition on any project or task order work.

1.3 The County reserves the right to award this contract to multiple vendors. The County reserves the right to award in whole or in part, by item or group of items, by section or geographic area, or make multiple awards, where such action serves the County's best interest.

2.0 SPECIFICATIONS

2.1 TECHNICAL REQUIREMENTS

2.1.1 Electrical Conductors

The work under this section shall consist of furnishing and installing electrical conductors for traffic signals and intersection lighting in accordance with the Traffic Signal Plan, requirements of these specifications, and Maricopa Association of Governments (MAG) specifications.

2.1.1.1 Material Requirements

2.1.1.1.1 Electrical Conductors

2.1.1.1.1.1 The wire shall be annealed copper and shall be uncoated unless otherwise specified. The wire shall be solid for number 10, 12 and 14 American Wire Gauge (AWG) and smaller diameter wire, conforming to the requirements of American Society for Testing and Materials (ASTM) B 3 for annealed bare copper wire. Conductors for sizes number 8 AWG and larger diameter wire shall be stranded and shall conform to ASTM B 8 for Class B stranding, unless otherwise specified, the conductors shall be insulated with Thermoplastic Heat and Water Wire (THW) grade thermoplastic compound and shall meet the requirements of Underwriters Laboratories (UL) 83. Insulation colors shall be permanent and an integral part of the insulation and shall not be applied as a surface treatment of coating. The insulation

thickness shall conform to the requirements of the National Electrical Code (NEC) . Conductor insulation shall be a solid color unless otherwise specified. The color shall be continuous over the entire length of the conductor.

2.1.1.1.1.2 Wire and cable shall be UL listed and rated at 600 volts. The UL label shall be present on each reel, coil or container of wire or cable. When requested, the contractor shall submit to the engineer the manufacturer's written certification that the product conforms to the requirements of these specifications.

2.1.1.1.1.3 All single conductors shall have plain, distinctive and permanent markings on the outer surface throughout their entire length showing the manufacturer's name or trademark, insulation type, conductor size, voltage rating and the number of conductors in the cable. Insulation colors shall be permanent and an integral part of the insulation and shall not be applied as a surface treatment coating.

2.1.1.1.1.4 Conductor colors and sizes for use in traffic signal and intersection lighting shall be as specified on the Traffic Signal Plan conductor schedule, and MCDOT Details 4799-1 and 4799-2.

2.1.1.1.1.4.1 Loop Detector Lead-In Cables: Loop detector lead-in shielded cables shall be two conductor, stranded, twisted pair, tinned copper, polyethylene insulated cable with a polyethylene jacket, rated at 600 volts and 140 degrees Fahrenheit and shall be in conformance with International Municipal Signal Association (IMSA) Specification 50-2.

2.1.1.1.1.4.2 Wire Tagging: Individual conductors for each vehicular and pedestrian phase group shall be secured together by two layers of plastic electrical tape and tagged with an approved wire Identification (I.D.) marker (3M Scotchcode Wire Marker Tape or approved equal). Cables for each vehicular

and pedestrian phase group shall be wrapped with two layers of plastic electrical tape and tagged with an approved wire I.D. marker (Scotchcode all cabinets and in pull boxes).

When IMSA cable is specified, wire insulation color assignment shall be in accordance with MCDOT Details 4799-1 and 4799-2.

2.1.1.1.1.4.3 IMSA Cables: IMSA cable shall be used when specified on the plans. IMSA cables shall be polyethylene insulated copper conductors, polyvinyl chloride jacketed, rated at 600 volts for use in underground conduit or as aerial cable conforming to IMSA Specification 19-1.

The IMSA 19-1 cable shall be provided with the number and size of conductors as specified on the plans. The colors and tracers shall be permanent and an integral part of the insulation and shall not be painted, surface coated or adhered to surface. Ink strips are unacceptable. Conductor insulation colors shall be standard IMSA colors (as shown by the following table). Cable conductor color, phase and interval assignments shall be in accordance with MCDOT Details 4799-1 and 4799-2.

2.1.1.1.1.4.4 Telephone Communication Cable: Telephone communication cable shall be used when specified on the plans. Telephone communication cable shall be in accordance with IMSA Specification 40-2. Cable shall be 19 AWG, 25 conductor, solid, twisted pair, polyethylene jacketed, with a rating of 300 volts.

Conductor Number	Insulation Color	Stripe Color	Conductor Number	Insulation Color	Stripe Color
1	Black	-	11	Blue	Black
2	White	-	12	Black	White
3	Red	-	13	Red	White
4	Green	-	14	Green	White
5	Orange	-	15	Blue	White
6	Blue	-	16	Black	Red
7	White	Black	17	White	Red
8	Red	Black	18	Orange	Red
9	Green	Black	19	Blue	Red
10	Orange	Black	20	Red	Green

2.1.1.2 Wiring Procedures

2.1.1.2.1 General Requirements

2.1.1.2.1.1 All wiring shall be in conformance with the NEC and the requirements of these specifications. All wire nuts and other wiring devices shall be UL listed. Conductor sizes and colors shall be as specified on the Traffic Signal Plan conductor schedule. Conductors shall be pulled into runs in a smooth continuous Approved lubricants shall be used for inserting conductors in conduit. Before installation, conductors' ends shall be taped for moisture protection until connections are made. Splices are permitted in pull boxes, pedestals and cabinets.

2.1.1.2.1.2 Conductors shall have a minimum of 36 inches of slack from the conduit end bell in the pull box.

2.1.1.2.1.3 All phase wiring shall be boxed at the intersection, terminated and spliced in the number seven pull boxes.

2.1.1.2.1.4 Conductor Splices

2.1.1.2.1.4.1 Splices shall be made utilizing wire nut connectors (Ideal model numbers 451, 452 and 454, or approved equal). Wire stripping length and wire size combinations shall be in accordance with the manufacturer's instructions supplied with the wire nut connector. Soldered connections will not be permitted. All phases shall be spliced in all pull boxes and unused phase wiring

shall be spliced to the ground rod in the controller cabinet.

2.1.1.2.1.4.2 Splices shall be dipped or brushed with a minimum of three coats of liquid waterproof splicing compound (3M Scotch Kote or approved equal). The finished splices shall be such that their electrical and mechanical characteristics and insulation quality are equal to those of the original cable.

2.1.1.2.1.5 Bonding and Grounding

2.1.1.2.1.5.1 All metallic enclosures such as cabinets, pedestals, poles, conduit and cable sheaths shall be bonded to form a continuous grounded system. Non-metallic portions of the system, such as PVC conduit, shall have a No. 8 AWG bare copper bond wire installed with suitable connections to form a continuous grounded system.

2.1.1.2.2 At each service disconnect, cabinet foundation, or where otherwise specified, an approved copper-plated ground rod shall be installed. Each ground rod shall be a one-piece solid rod of the copper weld type or approved equal and shall be a minimum of five-eighths inch in diameter and 10.0 feet long. The rod shall be driven vertically into the ground to a minimum 9.0 feet below the surface. If the rod cannot be driven vertically it shall be installed in accordance with Article 250-83 of the NEC. The ground rod may be located in a pull box. The service equipment neutral (grounded conductor) and the system grounding conductor (No. 8 AWG bond, solid) shall be connected to the ground rod with a copper-plated bolt or a brass bolt on the ground clamp.

2.1.1.2.3 The grounding electrode system shall be in accordance with articles 250-81 and 250-83 of the NEC.

2.1.1.2.4 Pole foundations shall have 25 feet of number four AWG bare copper conductor coiled and placed at the bottom of the excavation before concrete is poured. Pole foundation grounding electrodes shall be connected to the pole grounding screw in the hand hole with an approved lug connector.

2.1.1.2.5 A ground resistance test shall be performed for each installed ground rod prior to final connection of the utility service. Pole foundation coil grounds shall be tested as determined by the engineer in the field.

2.1.1.2.6 The ground resistance shall be measured with a three terminal, fall of potential, direct reading, battery powered earth tester with a 0.50-to-500-ohm scale or digital read-out. The 25-ohm reading shall be approximately at mid-scale.

2.1.1.2.7 The test shall be performed according to the manufacturer's instructions and Occupational Safety and Health Administration (OSHA) requirements. Two auxiliary copper clad ground rods shall be driven into the ground a minimum of three feet. The lateral spacing for each test rod shall be given in writing on the test report form and the spacing shall be approved by the engineer.

2.1.1.2.8 All tests shall be performed in the presence of the engineer and the test results shall be written down, dated and given to the engineer for approval.

2.1.1.2.9 Each ground rod or foundation ground shall be isolated with the bond wires disconnected when the test is being performed. The resistance to ground shall be 25 ohms or less. If it is not, additional ground rods shall be installed as required at least 15 feet from the original ground and shall be bonded to it. The test shall then be repeated for multiple grounds as necessary to achieve proper grounding below 25 ohms. As many additional ground rods shall be installed as is necessary to achieve proper grounding of 25 ohms or less.

2.1.1.2.10 The test shall be performed when the soil is dry. Contractor shall not add any chemical, or salt solutions to any portion of the grounding system. All grounding rods and foundation grounds to be tested shall be installed a minimum of ten days prior to testing unless otherwise determined by the engineer in the field.

2.1.1.2.11 Electrolytic grounding may be used in lieu of ground electrodes for the cabinet grounding system. Electrolytic grounding systems shall be self-activating, sealed and maintenance free. Electrolytic ground systems shall use a hydroscopic tool to extract moisture from the air to activate the electrolytic process without addition of chemicals or water.

2.1.1.2.12 Hazardous material shall not be used to improve the performance of the electrolytic ground. Electrolytic systems shall be UL listed and have a minimum life expectancy of 30 years.

2.1.1.2.13 Following installation, the contractor shall verify the resistance to ground of the cabinet grounding system is less than five ohms using the three-terminal fall of potential method. If the tested resistance is greater than five ohms, the contractor shall install as many ground electrodes as is necessary to meet the requirement.

2.1.1.3 Measurement

Conductors for traffic signals and intersection lighting will be measured on a lump sum basis.

2.1.1.4 Payment

Conductors, measured as provided in section 2, will be paid for at the contract lump sum price, which price shall be full compensation for the item.

2.1.2 Fiber Optic Cable and Equipment

The work under this section shall consist of furnishing, installing, and testing underground and outdoor fiber optic cable and related equipment, including trunkline cable, branch cable, jumper cable, pigtails, connectors, patch panels, splice trays, splice units, termination units, splice and termination units, and underground splice closures.

2.1.2.1 Material Requirements

2.1.2.1.1 Fiber Optic Cable: Unless otherwise stated, all fiber optic cable shall be single mode fiber optic (SMFO) cables that are of loose tube construction, filled with a dry waterblocking material, outer jacket shall be riser plenum outdoor rated High-Density Polyethylene and constructed by a certified ISO 9001 or 9002 manufacturer.

2.1.2.1.2 Fiber optic cable shall be dielectric and comply with the requirements of US Department of Agriculture Rural Utility Services specification RUS 1755.900, IEC 60793, and ITU G652.D except as modified by the Specifications. The fiber optic cable shall comply with GR20-CORE, EIA/TIA, and REA/RUS PE-90. The color code shall comply with ANSI/EIA 359-A, 598-A, IEC 60304. Fiber optic cable installed indoors shall also comply with the requirements of Article 770 of the NEC.

2.1.2.1.3 Fiber Optic Cable Performance and Construction

2.1.2.1.3.1 Use fiber optic cable that complies with the following requirements:

Cladding diameter	125 ± 0.7 µm
Core-to-cladding offset	≤ 0.8 µm
Cladding non-circularity	≤ 0.5 percent
Maximum attenuation	≤0.35 dB/km at 1310 nm; ≤0.25 dB/km at 1550 nm
Microbend attenuation (1 turn, 32 mm diameter)	≤ 0.05 dB at 1550 nm
Microbend attenuation (480 turns, 75 mm diameter)	≤ 0.05 dB at 1310 nm
Allowable Bending Radius for Fiber	≥ 15 mm
Attenuation uniformity	No point discontinuity greater than 0.05 dB at either 1310 nm or 1550 nm

Mode-field diameter (matched cladding)	8.6 ± 0.4 µm at 1310 nm; 10.5 ± 1.0 µm at 1550 nm
Maximum chromatic dispersion	≤ 3.5 ps/(nm x km) from 1285 nm to 1330 nm and < 18 ps/(nm x km) a1 1550 nm
Fiber polarization mode dispersion	≤ 0.2 ps/(km)1/2
Fiber coating	Dual layered, UV cured acrylate applied by the fiber manufacturer
Coating diameter	245 µm ± 5 µm
Minimum storage temperature range for Cable	-40 degrees Celsius to +75 degrees Celsius (-40 degrees Fahrenheit t to 167 degrees Fahrenheit t)
Minimum operating temperature range for Cable	-20 degrees Celsius to +70 degrees Celsius (-4 degrees Fahrenheit t to 158 degrees Fahrenheit t)
Rated life	Certify a 25-year life expectancy when installed to manufacturer's specifications
Ensure the change in attenuation for single mode from -20 degrees Celsius to +70 degrees Celsius (-4 degrees Fahrenheit to 158 degrees Fahrenheit) does not exceed 0.2 dB/km at 1550 nm, with 80 percent of the measured values no greater than 0.1 dB/km at 1550 nm.	

2.1.2.1.3.2 Buffer Tubes

2.1.2.1.3.2.1 Each buffer tube shall be filled with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous powder that is free from dirt and foreign matter. The powder shall allow free movement of the fibers, without loss of performance, during installation and normal operation including expansion and contraction of the buffer tubes. The powder shall be readily removable with conventional nontoxic solvents.

2.1.2.1.3.2.2 Buffer tubes shall be stranded around a central member using the reverse oscillation or "S-Z", stranding process. Use filler rods when needed in trunkline cable to lend

symmetry to the cable section.

2.1.2.1.3.2.3 The nominal outer diameter of the tubes shall be 2.7 millimeter (mm) for tubes with 12 fibers or less.

2.1.2.1.3.3 Central Strength Member

2.1.2.1.3.3.1 The fiber optic cable shall have a central strength member designed to prevent buckling of the cable. The central member shall be covered with a super absorbent polymer in order to prevent water migration through the center of the cable core should the core become exposed.

2.1.2.1.3.4 Cable Core

2.1.2.1.3.4.1 The fiber optic cable shall use a dry water-blocking material to block the migration of moisture in the cable interstices.

2.1.2.1.3.4.2 Two polyester yarn binders shall be applied counter-helically in order to secure the buffer tubes to the central member. The binders shall not crush or deform the buffer tubes. The binders shall be non-hygroscopic, non-wicking and dielectric with low shrinkage.

2.1.2.1.3.4.3 For single layer cables, the yarn binders shall contain super absorbent polymers to prevent water migration.

2.1.2.1.3.5 Tensile Strength Members

2.1.2.1.3.5.1 The fiber optic cable shall have tensile strength members designed to minimize cable elongation due to installation forces and temperature variation.

2.1.2.1.3.5.2 Underground fiber optic cable shall withstand a 600

pounds tensile load applied per the Energy Information Administration EIA-455- 33 where the change in attenuation does not exceed 0.2 decibels (dB) during loading and 0.1 dB after loading. Use cable rated for an installed tensile service load of 200 pounds or more.

2.1.2.1.3.6 Cable Jacket

2.1.2.1.3.6.1 The fiber optic cable jacket shall be constructed of medium density polyethylene (MDPE) that has been applied directly over the tensile strength members and water-blocking material. The jacket shall have at least one ripcord designed for easy sheath removal.

2.1.2.1.3.7 Cable Markings

2.1.2.1.3.7.1 Provide cable with markings that include cable length markings (in feet) and the year of manufacture. In addition, provide cable with markings, “MCDOT ITS BRANCH, MCDOT ITS TRUNK” to distinguish between trunkline (between communication hubs) and branch cables (spliced to trunkline cables). All cable markings shall be labeled with indelible markings.

2.1.2.1.3.8 Environmental

2.1.2.1.3.8.1 Cable shall be capable of withstanding the following conditions without damage or decrease in function:

2.1.2.1.3.8.1.1 Cable operating temperature per EIA/TIA-455-03;

2.1.2.1.3.8.1.2 Total immersion in water with natural mineral and salt contents;

2.1.2.1.3.8.1.3 Salt spray or saltwater immersion for extended periods; and

2.1.2.1.3.8.1.4 Wasp and hornet spray.

2.1.2.1.4 Cable Length and Shipping: Base the length of each fiber optic cable on field measurements. Include in the measurement, the required amount of slack cable at pull boxes, field cabinets, hubs, and equipment racks as required by the plans.

2.1.2.1.4.1 Stencil, letter, or provide the following information on a weatherproof tag firmly attached to the reel.

2.1.2.1.4.1.1 Factory order number;

2.1.2.1.4.1.2 Job number;

2.1.2.1.4.1.3 Ship date;

2.1.2.1.4.1.4 Manufacturer's cable code;

2.1.2.1.4.1.5 Type of cable (single mode, outdoor);

2.1.2.1.4.1.6 Beginning and ending length markings; and

2.1.2.1.4.1.7 Measured length and attenuation.

2.1.2.1.5 Trunkline Fiber Optic Cable: Trunkline fiber optic cable shall have a minimum of 96 fibers, with 12 fibers per buffer tube.

2.1.2.1.6 Branch Fiber Optic Cable: Branch fiber optic cable shall have a minimum of 12 fibers, with 12 fibers per buffer tube.

2.1.2.1.7 Fiber Optic Jumper Cable: Jumper cables shall meet the following requirements:

2.1.2.1.7.1 250 Micrometer[2] (µm) buffering of each fiber;

2.1.2.1.7.2 900 µm buffering of each fiber applied after the initial 250 µm buffering;

2.1.2.1.7.3 Maximum factory measured insertion loss of 0.5 dB per EIA/TIA 455-171;

2.1.2.1.7.4 Less than 0.2 dB loss when subjected to EIA/TIA-455-1B, 300 cycles, 0.5 kilogram;

2.1.2.1.7.5 Aramid yarn strength member;

2.1.2.1.7.6 Rugged 0.12 inches (approximate) polyvinyl chloride (PVC) sheathing;

2.1.2.1.7.7 Minimum bend radius of 12 inches following installation, 25 inches during installation;

2.1.2.1.7.8 Minimum tensile strength of 480 pounds;

2.1.2.1.7.9 Ultra-Physical Connector (UPC) Lucent Connector (LC) Connectors that are factory terminated; and

2.1.2.1.7.10 Lanyard dust caps for fiber optic connectors.

2.1.2.1.8 Fiber Optic Pigtail: Fiber optic pigtails shall meet the requirements for jumper cable, except as amended by this section. Pigtails that are totally contained within a fiber optic splice or termination unit, need not have a 0.12 inches PVC jacket. All fiber optic pigtails shall be UPC type LC. The other end shall be left bare for splicing to fiber.

2.1.2.1.9 Fiber Optic Connectors

2.1.2.1.9.1 Fiber optic connectors shall meet the following requirements:

2.1.2.1.9.1.1 Pre-installed by the cable manufacturer;

2.1.2.1.9.1.2 Type shall be factory machine polished UPC LC and factory terminated;

2.1.2.1.9.1.3 Designed for terminating single mode fiber with 125 µm cladding;

2.1.2.1.9.1.4 Return loss factory-measured – 55 dB (UPC) or less from -40 degrees Celsius to +70 degrees Celsius (-40 degrees Fahrenheit to 158 degrees Fahrenheit);

2.1.2.1.9.1.5 Factory-measured attenuation less than 0.5 dB; and

2.1.2.1.9.1.6 Connector attenuation will not change more than 0.2 dB following 4800 re-mating's and

2.1.2.1.9.1.7 Lanyard dust caps for fiber optic connectors.

2.1.2.1.9.2 Connectorized cable shall have strain relief boots that can withstand an axial pull of 25 pounds with no physical damage to the connector or performance of the fiber.

2.1.2.1.9.3 Hand polished connectors are not authorized for use.

2.1.2.2 Fiber Optic Splice And Distribution Equipment

2.1.2.2.1 Fiber Optic Patch Panels

2.1.2.2.1.1 Fiber optic patch panels shall have protective covers for all unused couplers.

2.1.2.2.2 Splice Trays

2.1.2.2.2.1 Splice trays shall be designed specifically for housing single mode fusion splices protected by heat-shrink sleeves. Splice trays shall be easy to install and remove and have provisions for a minimum entry of four buffer tubes.

2.1.2.2.3 Fiber Optic Splice and Termination Units: Fiber optic splice and fiber optic termination units shall be properly sized for the required number of splices and terminations subject to the minimum requirements stated for each configuration. Fiber optic splice and termination units shall meet the following requirements:

2.1.2.2.3.1 Have provisions for minimum of six fiber optic cable entries;

2.1.2.2.3.2 Rack mounted;

2.1.2.2.3.3 Have front and rear doors or removable panels;

2.1.2.2.3.4 Have a top, bottom, and four sides that fully enclose the interior and protect its contents from physical damage;

2.1.2.2.3.5 Manufactured using 16-gauge aluminum or approved equivalent and corrosion resistant;

2.1.2.2.3.6 Provisions for neatly routing cables, buffer tubes, and fan-out tubing;

2.1.2.2.3.7 Have internal feed-through provisions that allow cables to be internally routed between two units installed adjacent to each other; and

2.1.2.2.3.8 Have provisions for externally securing the fiber optic cable, sheath, and central strength member.

2.1.2.2.3.9 Suited for Patch and Splice Modules

2.1.2.2.3.10 Include removable front and rear fiber routing guides

2.1.2.2.3.11 Textured black powered coat finish

2.1.2.2.3.12 4RU Panels conforming to 15.5 x 17 x 15 x 7 (inches)

2.1.2.2.3.13 Aluminum construction per ASTMB209

2.1.2.2.3.14 Unloaded weight of nine (four Rack Units RU), five pounds (2RU), and four pounds (one RU)

2.1.2.2.3.15 Use Light Guide Cross-connect (LGX) interconnect platform

2.1.2.2.3.16 Fiber Optic Splice Units

2.1.2.2.3.16.1 Fiber optic splice units shall consist of a single housing with provisions for installation of multiple splice trays as required. The splice unit shall have provisions for future installation of two splice trays of minimum twelve splice capacity each, in addition to the required amount.

2.1.2.2.3.16.2 The splice unit shall have a pull-out shelf that allows easy access to the splice tray, buffer tube and fiber storage area that permits fusion splicing to be conducted at a minimum distance of 16 feet from the housing. Units with hinged shelves are not acceptable. The following permanent marking shall be provided on the door or front access

panel: "Communication Fiber Optic Cable Splice Area Inside".

2.1.2.2.3.16.3 Fiber optic splice units shall consist of a single modular housing. Each patch and splice module should use Single Mode Fiber (SMF) 28E fiber that can be configured for a minimum of 12 and up to 24 fiber splices to LC connectors and corresponding bulkheads. These patch and splice modules should be self-contained with the bulkheads providing one connection interface and the internal splice chips providing the other connection interface. Mounting provisions for the patch and splice modules should include individual rack or wall-mountable brackets that allow for setup in limited-space applications.

2.1.2.2.3.17 Fiber Optic Termination Units

2.1.2.2.3.17.1 Fiber optic termination units shall consist of a single housing with provisions for installation of one or more patch panels as required. Patch panels shall face to the front of the rack.

2.1.2.2.3.17.2 Fiber optic termination units shall have cable management brackets or rings, integral to the unit, that secure and support cables between patch panels or splice trays to the vertical rack members while maintaining a minimum one and half inch cable radius. Jumper cable troughs may be provided in lieu of this requirement.

2.1.2.2.3.17.3 The following permanent marking shall be provided on the front of the unit: "Communication Fiber

Optic Cable Termination Area Inside".

2.1.2.2.3.17.4 Integrated Fiber Optic Splice and Termination Units: Integrated fiber optic splice and termination units shall consist of a single housing with provisions for patch panels and splice trays. Integrated splice and termination units shall meet the requirements stated herein for splice units and termination units.

2.1.2.2.3.17.5 The following permanent marking shall be provided on the door or front access panel: "Communication Fiber Optic Cable Termination and Splice Area Inside".

2.1.2.2.4 Jumper Cable Troughs: Jumper cable troughs shall be designed to secure, support, store, and horizontally route jumper cables and other fiber optic cables from vertical frame members on one side of the rack, to vertical frame members on the other side of the rack. Jumper cable troughs shall be designed to maintain the manufacturers minimum bend radius for jumper cables cable bend radius when transitioning from the trough to vertical frame member. The capacity of each cable trough shall exceed the number of jumpers it houses. The finish of the jumper cable troughs shall match the finish of the fiber optic termination equipment.

2.1.2.2.5 Underground Splice Closures: Underground splice closures shall be cylindrical, butt-end style, corrosion resistant, water-tight, and meet the requirements of GR-771-CORE. Underground splice closures shall seal, bond, anchor, and provide efficient routing, storage, organization, and protection for fiber optic cable and splices. Internal configuration shall have end cap with a minimum of two express ports for entry and exit of uncut trunkline cable and a minimum of three additional ports for branch cables.

2.1.2.2.5.1 The splice enclosure shall be designed to seal terminations using gel-sealing technology. The use of heat-shrink is no longer authorized. The gel seal cable terminations shall automatically adjust to the cable size and shape, and require no special tools, tapes or mastics to install. The splice enclosure shall support a minimum of 96 splices.

2.1.2.2.5.2 Splice closures shall have a reliable seal design with both the cable jackets and core tube sealed, without the use of water-blocking materials. The gel seals shall be reusable, and cabling shall be easy to remove. The splice closure shall be opened and completely resealed without loss of performance. Use splice closures that are at least 12 inches shorter in length than the inside long dimension of the pull box.

2.1.2.3 Construction Requirements

2.1.2.3.1 Fiber Optic Cable: Approval of the fiber pulling plan is required prior to any installation of fiber optic cable. The ITS inspector shall be present at all times during the installation of fiber optic cable.

2.1.2.3.2 The pull tape shall be threaded through the pulling eye and sewn back onto itself to reduce the possibility of breakage. A swivel shall be used between the tape and cable to prevent cable twisting. Tension-sensitive, breakable links shall be used to protect the fiber optic cable from over-tension for pulls over 700 feet.

2.1.2.3.3 Contractor shall install fiber optic cable continuous and without splices between allowable splice points as identified on the plans and in the specifications. Only splice fibers in splice closures and at fiber optic splice units that are housed at hub locations and/or the Traffic Management Center (TMC). Contractor shall perform all final length measurements and order cable accordingly.

2.1.2.3.4 Contractor shall:

2.1.2.3.4.1 Carefully handle fiber optic cable;

2.1.2.3.4.2 Not pull cable along the ground or over or around obstructions;

2.1.2.3.4.3 Not pull cable over edges or corners, over or around obstructions or through unnecessary curves or bends;

2.1.2.3.4.4 Not exceed fiber optic cable bend radius at any time;

2.1.2.3.4.5 Not exceed the maximum pulling tensions at any time; and

2.1.2.3.4.6 Use manufacturer approved pulling grips, cable guides, feeders, shoes and bushings to prevent damage to the cable during installation.

2.1.2.4 When removing cable from the reel prior to installation, shall be placed in a “figure-eight” configuration to prevent kinking or twisting. Contractor shall take care to relieve pressure on the cable at crossovers by placement of cardboard shims (or approved equivalent method) or by

creating additional “figure-eight”. If storing cable, use a cable reel for long lengths and for short lengths store in a “figure eight” pattern larger than the fibers minimum bend radius.

2.1.2.5 Contractor shall furnish the engineer with the cable manufacturer's recommended procedures, maximum pulling tension, a list of the cable manufacturer's approved pulling lubricants, and the lubricant manufacturer’s procedures for use. Contractor shall adhere to the manufacturer's installation procedures when installing fiber optic cable. The pulling tension shall be monitored using a strip chart recorder when mechanical pulling techniques are used. If at any time during the pull the cable tension is at 85 percent of the maximum allowed, the contractor shall stop the pull and troubleshoot the problem to determine if there is an obstruction, low lubricant, or other difficulties that may cause a high-tension problem. After the tension problem has been thought to have been resolved, continue the pull, and closely monitor the cable tension. If the problem continues, the contractor shall notify the engineer of the problem and cease installation until the problem can be identified.

2.1.2.6 High-performance fiber optic cable lubricant shall be used to lubricate the conduit for long cable duct pulls beyond 700 feet or pulls with numerous turns totaling over 180 degrees. The lubricant must be suitable for outdoor temperatures, flame retardant, unable to affect the properties of the cable jacket, and have a low coefficient of 0.25 when used on Polyethylene (PE) jacketed or other types of cables. The lubricant should be present at all points of the duct, cable feed locations, intermediate pull locations, bend locations and approved by UL or Canadian Standards Association (CSA). The lubricant shall be applied with a lubricant collar and pump. Contractor shall use lubricants in quantities and in accordance with the procedures recommended by the lubricant manufacturer.

2.1.2.7 Contractor shall furnish attachment hardware, installation guides, and other necessary equipment, not specifically listed herein, as necessary to install the fiber optic cable.

2.1.2.7.1 Underground Fiber Optic Cable

2.1.2.7.1.1 At each splice point, coil 75 feet of slack fiber optic cable per cable entry. Each #9 pull box without a splice closure shall have a minimum of 150 feet of fiber optic cable slack installed. At each intermediate No. 7 ITS Pull Box the contractor shall install 25 feet of slack per cable. At each field cabinet, provide a minimum of 16 feet of slack for each fiber optic cable. All cable shall be stowed per project plans and MCDOT Standard Details.

2.1.2.7.1.2 Underground fiber optic cable shall be installed only in fiber optic conduit, unless shown otherwise in the plans. Do not direct bury underground fiber optic cable.

2.1.2.7.1.3 If the cable is pulled by mechanical means, the contractor shall obtain the engineer’s approval for the cable pulling equipment. Cable pulling equipment shall have a mechanism to ensure that the maximum

allowable pulling tension is not exceeded at any time during installation.

2.1.2.7.2 Outdoor Fiber Optic Cable Installed Indoors

2.1.2.7.2.1 For outdoor fiber optic cable installations indoors, the contractor shall follow the requirements of local building codes and NEC Article 770, inclusive of the Fine Print Notes.

2.1.2.7.2.2 Splices for outdoor fiber cable installed indoors shall be housed in a rack-mounted fiber optic splice unit or integrated fiber optic termination unit. Coil 16 feet of slack fiber optic cable and stow it in the rack.

2.1.2.7.3 Fiber Optic Jumper Cable

2.1.2.7.3.1 Install jumper cables only in field cabinets and indoor locations. Provide permanent markings on duplex jumper cables that provide a visual distinction between the two fibers. Provide strain relief for jumper cables at both ends and elsewhere as needed. Adhere to manufacturer recommended installation and minimum bend radius requirements.

2.1.2.7.4 Fiber Optic Pigtails

2.1.2.7.4.1 Install fiber optic pigtails only in enclosed fiber optic splice and termination units located in field cabinets and indoor locations. When splicing pigtails to individual fibers, match the color of single fiber pigtails with the color of the fiber. Alternatively, single fiber pigtails may be routed through colored fan-out tubing that matches the color of the fiber.

2.1.2.8 Splicing and Terminations: Only splice fibers at locations that are identified on the splice tables in the plans. Splice tables in the plans shall not be revised without approval from the engineer. All splices shall be protected and stored in underground splice closures for outdoor installations, and in fiber optic splice units or integrated fiber optic splice and termination units for indoor installations.

2.1.2.9 For indoor installations, the fiber optic cable shall enter the rear of the fiber optic splice unit or integrated fiber optic splice and termination unit. The fiber optic cable sheath and central member shall be secured inside the unit prior to buffer tube fan-out. All entry holes not used shall be plugged. Buffer tubes with fiber designated for splicing shall be routed into and secured in a splice tray. Remaining buffer tubes shall be secured within the splice unit and not accessed.

2.1.2.9.1 Splicing Methods

2.1.2.9.1.1 All splices shall be accomplished by means of the fusion splice technique. Each splice shall not add more than 0.1 dB attenuation when splicing new fiber to new fiber, and 0.3 dB attenuation when splicing new fiber to existing fiber. Splices found to exceed the maximum allowed dB attenuation when tested with an OTDR shall be re-spliced, at no additional cost, until this requirement is met.

2.1.2.9.1.1.1 Each splice shall be packaged in a protective heat-shrink sleeve and secured in the splice tray. The heat-shrink sleeve shall be approved for use by the fiber optic cable manufacturer and installed in such a manner as to protect the fiber from scoring, dirt accumulation, moisture intrusion, and microbending.

2.1.2.9.1.1.2 All fibers in a buffer tube shall be spliced within the same splice tray. When splicing to fiber optic pigtails, use spiral wrap (or similar approved method) to group and protect pigtails routed from each splice tray to the corresponding patch panel.

2.1.2.9.1.1.3 Fiber optic cable splices will fall into one of the following categories:

2.1.2.9.1.1.4 Mid-cable splices: Perform mid-cable splices when splices are not required for all fibers of a cable. Only fibers within a buffer tube that are designated for splicing shall be accessed, spliced, and secured neatly within the splice tray. The remaining fibers in the buffer tube that are not designated for splicing shall be secured neatly within the splice tray and not cut. Removal of the buffer tube to access the fibers shall be accomplished using

equipment specifically designed for buffer tube removal without damaging the individual coated fibers.

2.1.2.9.1.1.5 Full-cable splice: Perform full-cable splices when the distance exceeds the maximum length of fiber optic cable available on a reel. All fibers, including spares, shall be spliced together to provide a continuous optical path. All fibers shall be secured neatly within the splice trays.

2.1.2.9.2 Termination Methods

2.1.2.9.2.1 Use Lucent Connector (LC) connectors for terminating fiber optic cables to equipment and patch panels in field cabinets. Use cables with LC type connectors for terminating fiber optic cables at patch panels located at hubs and the TMC.

2.1.2.9.2.1.1 All connector types shall use an Ultra Physical Contact (UPC) machine polished connector. No hand polishes are permitted or authorized.

2.1.2.9.2.1.2 Measured attenuation at each termination (inclusive of two connectors and coupler) shall not exceed 0.5 dB.

2.1.2.9.2.1.3 Fiber terminations shall be neatly, and permanently labeled on the connector module to designate transmit or receive (when appropriate) and the fiber optic strand number or other designation as determined by the engineer. Spare fibers shall be terminated when called for by the plans and labeled as determined by the engineer.

2.1.2.9.2.1.4 Protective covers shall be used on all optical connectors and

terminations at all times until terminated.

2.1.2.9.2.1.5 Field Termination: Termination in traffic signal cabinets, ITS field cabinets and ITS field node cabinets. Termination of fiber optic cable at traffic signal cabinets, ITS field cabinets and ITS field node cabinets shall be accomplished by fusion splicing fiber to factory prepared, fiber optic pigtails with LC connectors terminated at patch panels. Jumper cables shall have LC connectors. Field termination of fibers to connectors shall not be permitted.

2.1.2.9.2.1.6 Termination at Hubs and TMC: Termination of fiber optic cable at hubs and the TMC shall be accomplished by fusion splicing fiber to factory prepared, fiber optic pigtails with LC connectors terminated at patch panels. Jumper cables shall have LC connectors. Field termination of fibers to connectors shall not be permitted.

2.1.2.9.3 Fiber Optic Distribution Equipment: Contractor shall install a sufficient number of patch panels to terminate all fibers. Blank patch panel covers, of same finish and manufacture as the patch panel, shall be installed for all unused patch panel spaces on fiber optic termination units.

Fiber optic patch panels shall have couplers to allow applications to be easily installed and removed from the termination housing.

2.1.2.9.4 Labeling: Comply with the requirements of Section 2.1.8.2.1.

2.1.2.10 Testing Requirements

Fiber optic cable and distribution equipment shall meet the following certification, factory and stand-alone test requirements. General test requirements are covered in this section. See Figure 2.1.2.10.3 for a Sample Fiber Test Report.

The ITS inspector shall be present at all times during the testing of fiber optic cable.

2.1.2.10.1 Design Approval Tests (DAT): Submit certification or test results for all required factory testing of fiber optic cable. Submittal of RUS certification will satisfy this requirement for the tests that are required by Rural Utilities Service (RUS) 1755.900.

2.1.2.10.2 Factory Acceptance Tests (FAT): Test all fiber optic cable, pigtails, jumper cables and patch panels in the factory to demonstrate compliance with specification requirements. Submit a copy of the results of factory tests to the engineer.

2.1.2.10.3 Stand-Alone Tests

2.1.2.10.3.1 Pre-Installation Testing: Contractor shall visually inspect all cable and equipment upon delivery and again prior to installation. Test any equipment that is found to have visual damage. Contractor shall perform pre-installation on-reel testing of all fiber optic cable strands prior to installation. Test using an OTDR to ensure fiber optic cable strands are free of breaks and micro bends.

2.1.2.10.3.2 Post-Installation Testing: Contractor shall purchase legal copies of the testing standards listed below and provide them to the engineer a minimum of seven days prior to any fiber optic cable testing. The standards that are required to be purchased include:

2.1.2.10.3.2.1 EIA/TIA-526-7– "Measurement of Optical Power Loss of Installed Single-mode Fiber Cable Plant"

2.1.2.10.3.2.2 TIA/EIA-455-8 (FOTP8) – "Measurement of Splice or Connector Loss and Reflectance Using an Optical Time-Domain Reflectometer (OTDR)"

Prior to testing, the contractor shall furnish the engineer with a fiber optic testing plan and procedures. Testing of spare fiber is required. Contractor shall identify any unacceptable losses and make corrective actions at no additional cost. Failed splices may be remade and re-tested for compliance. Replace any cable in its entirety that is found not compliant to the Specifications. Perform the following post-installation tests using the procedures of TIA/EIA-526-7A and all standards and procedures invoked therein, subject to the following clarification:

Power Meter Tests: Contractor shall conduct unidirectional power meter tests for each fiber to measure installed fiber cable attenuation, demonstrate connectivity, and correct splicing. Contractor shall perform Power Meter Tests on each fiber strand in accordance with Method A.3 of TIA/EIA-526-7 – "Measurement of Optical Power Loss of Installed Single-mode Fiber Cable Plant" and submit test results for each fiber to the engineer as required by TIA/EIA-526-7. Submit test results for each link to the engineer. Power meter tests shall be conducted after all splices have been made and all connectors, jumper cables, and pigtails are in place. Each link shall be tested separately from each field cabinet to the respective trunk cable termination panel in the Hub(s) and from field cabinet to field cabinet for fiber links that do not go directly to a hub. The use of fiber optic jumpers to couple the connectors together in equipment cabinets to create a continuous end to end link shall not be permitted.

OTDR Tests: Contractor shall conduct bi-directional tests using an OTDR in accordance with TIA/EIA-455-8 (FOTP8) for each fiber strand from field cabinet to hub location, between hub locations, between field cabinet locations, inclusive of all branch cables, pigtails, and patch panels to demonstrate that attenuation for each fiber strand, termination, and splice, individually and as a whole, comply with allowable losses in accordance with the fiber assignment tables. Test fibers at 1310 nm and 1550 nm. The OTDR shall be set to operate in auto event mode with the event threshold set at 0.1dB or lower. Contractor shall submit printed and electronic OTDR traces for approval. Any electronic traces submitted that were shot without the auto events feature shall be re-tested by the contractor at no additional cost. Contractor shall clearly annotate each event (connector, pigtail, splice, etc.), event location, and identify the measured loss.

Following completion of all testing, and approval by the engineer, the contractor shall compile and submit two organized test file (electronic file) that include all required test results, summary tables, OTDR traces, and electronically saved test data. Test file (electronic file)–shall at a minimum, include the following:

2.1.2.10.3.2.3 Identification of each fiber by cable (as it is identified in the field), buffer tube, color, and string number as appropriate;

2.1.2.10.3.2.4 A summary sheet with each submittal that clearly illustrates length and measured loss versus budgeted loss for each fiber or connected fiber string as appropriate; and

2.1.2.10.3.2.5 Calculations and notations for each fiber and wavelength that include total loss, measured dB/km loss, the number of connectors/terminations, pigtails, and jumper cables and any anomalies over 0.1 dB.

Figure 2.1.2.10.3 Sample Fiber Test Report:

PROJECT:______________________

SAMPLE FIBER TEST REPORT

FIBER TEST SUMMARY REPORT

Fiber ID	From	To	Wavelength	Length	Number of Splices	Number of Connectors	Loss Budget (dB)	Loss A > B (dB)	Loss B > A (dB)	Loss Average (dB)	Pass/Fail
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
			1550 nm								
			1310 nm								
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2.1.2.11 Warranty Requirements

2.1.2.11.1 If specific warranty requirements apply, they are listed under specific equipment requirements of the specifications. The cost of warranties and repairs are included as part of the contract unit price.

2.1.2.11.2 Within 60 days following approval of material and equipment, the contractor shall submit a preliminary Warranty Administration Plan (WAP) to the engineer for approval.

2.1.2.11.3 The WAP is to address how the warranty period shall be administered, including the following requirements:

2.1.2.11.3.1 24/7/365 telephone number for MCDOT initiated warranty requests;

2.1.2.11.3.2 Repair or replace failed items that prevent normal operation of the system or any of the subsystems within five calendar days after notification. Respond to all other warranty requests within 14 calendar days;

2.1.2.11.3.3 Track each repair performed during the warranty period by serial number. Account for removals, replacements, and repaired items put back in service or into the spare inventory. Reset the warranty period for all repaired or replaced items. Establish a new warranty period for all new items;

2.1.2.11.3.4 Perform routine maintenance during the warranty period per vendor recommendations.

2.1.2.11.3.5 Provide a summary of all routine maintenance activities required, whether or not they fall within the one-year warranty period;

2.1.2.11.3.6 When used, replenish spare equipment inventory within two weeks, or stated vendor lead-time, whichever is greater;

2.1.2.11.3.7 Provide a complete list of equipment and vendor warranty periods, including spare equipment. Use Figure 2.1.2.11 or similar approved form; and

2.1.2.11.3.8 Provide copies of all warranty paperwork.

2.1.2.11.4 Submit a final WAP to the engineer for approval at least 45 days prior to final acceptance. An approved WAP is required prior to final acceptance.

2.1.2.11.5 Prior to final acceptance, furnish an inventory of spare parts.

2.1.2.11.6 Within 90 days and no later than 30 days prior to the end of the one-year warranty period, submit the following to the engineer for approval:

2.1.2.11.6.1 A complete list of all equipment (by serial number) that have warranties extending beyond the one-year warranty period, including spare equipment. Use Figure 2.1.2.11 or similar approved form; and

2.1.2.11.6.2 All warranty paperwork extending beyond the one-year period, transferring ownership of the warranties to MCDOT.

2.1.2.11.7 Repair or replace defective fiber optic cable and equipment for a period of two years following final acceptance of the system.

Figure 2.1.2.11 Equipment Warranties

Project Name Equipment Warranties Submitted By: Date:			Project No.: Federal Project No.:			
Serial #	Description	Location	Warranty Duration	Expiration Date	Date Received	Other Information

2.1.2.12 Documentation
The contractor will be responsible for providing the following deliverables listed below:

2.1.2.12.1 Deliver a minimum of two sets of maintenance manuals to the engineer for all furnished equipment. The manuals shall be supplied in durable, loose-leaf, three ring binders of appropriate size. All sections shall be permanently titled and have pages numbered and indexed for easy and efficient removal and replacement. In addition, an electronic copy of all manuals shall be provided for all equipment and software.

2.1.2.12.2 Format maintenance manuals in two sections that include the following material for all furnished equipment and components:

2.1.2.12.2.1 Section 1

2.1.2.12.2.1.1 Description for each type of equipment and its components.

2.1.2.12.2.1.2 Description of operation.

2.1.2.12.2.1.3 Troubleshooting procedures at system and device levels.

2.1.2.12.2.1.4 Preventative maintenance and adjustment procedures.

2.1.2.12.2.1.5 “As-built” drawings including block diagrams, signal path, and detailed device and system connection diagrams (reference Section 2.1.8.2.3).

2.1.2.12.2.1.6 Equipment source reference including manufacturer and nearest authorized service centers along with associated addresses and telephone numbers.

2.1.2.12.2.1.7 Final warranty administration plan.

2.1.2.12.2.2 Section 2

2.1.2.12.2.2.1 Manufacture’s operation and installation.

2.1.2.12.2.2.2 Manufacture’s service and repair guides.

2.1.2.12.3 Prior to installing fiber optic cable, the contractor shall provide a fiber pulling plan showing reel setup, assist winch, “figure eight”, and assist wheel locations. The fiber pull plan shall identify the estimated pulling tension, route length, number of turns, pull direction, splice enclosure locations, and accessibility. The fiber pulling plan should also include cable pulling lubricants, pulling grips, breakaway swivel, dynamometer, and any other hardware that will be used to assist in maintaining cable’s minimum bend radius. Contractor shall submit the fiber pulling plan to the engineer for review and approval two weeks prior to install. Contractor shall not install fiber optic cable without prior approval of the fiber pulling plan.

2.1.2.12.4 Contractor shall provide post installation as-built drawings that document fiber distances between manhole/handholes, splice locations, amount and location of coiled slack, and type, size, and number of installed fiber optic cables.

2.1.2.13 Training

2.1.2.13.1 When required, training shall be provided by the contractor in two sessions.

2.1.2.13.2 The first training session shall be for maintenance and troubleshooting. This session shall be a minimum of four hours in length for each type of field device installed,

including communications. This session shall be oriented for the County maintenance staff.

2.1.2.13.3 The second training session shall be for operations. This session shall be a minimum of four hours in length for each type of field device installed. This session shall be oriented for the County Traffic Management staff.

2.1.2.14 Measurement

2.1.2.14.1 Fiber optic cable will be measured by the linear foot for actual cable length installed, for each type installed. The length of cable required to be coiled for cable slack will be measured and included in the total measured amount.

2.1.2.14.2 Fiber optic splice units, termination units, integrated splice and termination units, and underground splice closures will be measured as a unit for each type installed.

2.1.2.14.3 Fiber optic jumper cables, pigtails, patch panels, terminations, splice trays, and splices are included as part of and considered incidental to the listed pay items.

2.1.2.15 Payment

2.1.2.15.1 The accepted quantities of items, measured as above, will be paid for at the contract unit price, COMPLETE IN PLACE. The cost of testing, warranty, documentation, and training are included in the unit price of each item.

2.1.3 Closed Circuit Television (CCTV)

The work under this section shall consist of furnishing, installing, and testing CCTV equipment including camera assemblies (camera systems and cables, lightning and surge protection), cabinets, software, and various accessories as needed.

2.1.2.3 Material Requirements

2.1.3.1.1 Camera Assembly: Provide a camera assembly that interoperates with an existing central software driver. All components of the camera assembly shall be off-the-shelf items.

2.1.3.1.1.1 Camera Assembly shall be an AXIS Q6075-E or equivalent

2.1.3.1.1.2 Contractor shall submit an original or copy of a Certificate of Compliance along with required equipment lists and supporting material, including warranty information to the engineer for approval as part of the material and/or equipment list.

2.1.3.1.1.3 If requested by the engineer, the contractor shall furnish laboratory results or independent certifications that substantiate compliance with the stated requirements.

2.1.3.1.1.4 Materials or equipment covered by the certificate may be sampled and tested at any time, and, if found not in conformity with the requirements of the project plans or specifications, will be subject to rejection, whether in place or not.

2.1.3.1.1.5 Certificate of Compliance shall contain the following information:

2.1.3.1.1.5.1 A description of the material or equipment supplied;

2.1.3.1.1.5.2 Means of material identification, such as label, lot number, or marking;

2.1.3.1.1.5.3 Statement that the material complies in all respects with the requirements of these Specifications. When identified in the Specifications, Certificates shall state compliance to specific cited standards, such as RUS 1755.900, NEMA TS-2, etc. and specific required tests, such as burn-through testing for fiber optic conduit;

2.1.3.1.1.5.4 Clearly state any exceptions to the requirements of the Specifications; and

2.1.3.1.1.5.5 The name, title, and signature of a person having legal authority to bind the manufacturer or the supplier of the material. The date of the signature shall also be given. The name and address of the manufacturer or supplier of the material shall be shown on the certificate. A copy or facsimile reproduction (FAX) will be acceptable; however, the original certificate shall be made available upon request. The person signing the certificate shall be in one of the following categories:

2.1.3.1.1.5.5.1 An officer of a

corporation.

2.1.3.1.1.5.5.2 A partner in a business partnership or an owner.

2.1.3.1.1.5.5.3 A general manager

2.1.3.1.1.5.5.4 Any person having been given the authority in writing by one of the three listed above.

2.1.3.1.1.5.6 Camera and Lens: Cameras shall produce quality video that is clear, low-bloom, low-lag, video with no jitter, interlace, pairing, or ghosting when viewed at the TMC. Cameras and lenses shall be provided that meet the following requirements:

Function/Feature	Requirement
Camera	Day/Night (35X), DSP, color, solid state
Signal Format	NTSC
Scanning System	2:1 Interlace
Image Sensor	¼ inch charged coupled device (CCD)
Effective Pixels	768 (H) X 494 (V) (NTSC)
Horizontal Resolution	> 520 TV Lines (NTSC)
Lens Mount	C-type lens mount or integrated camera/lens combination
Lens	f/1.2 (f = 3.8 - 91.2 mm optical) or better
Zoom	35X optical, 12X digital or better

Zoom speed (optical range)	3.2/4.6/6.6 seconds
Horizontal	55.8° at 3.4 mm wide zoom;
Angle of view	1.7° at 119 mm telephoto zoom
Focus	Automatic with manual override

Maximum Sensitivity @35 IRE NTSC/EIA	0.063 lux at 1/4 sec shutter (color) 0.55 lux at 1/60 sec shutter (color) 0.00018 lux at 1/2 sec shutter (B-W)
Sync System	Internal/AC line lock, phase adjustable via remote control, V-Sync
White Balance	Automatic with manual override
Shutter Speed NTSC	Automatic (electronic iris)/Manual 1/2 ~1/30,000
Iris Control	Automatic Iris Control with manual override
Gain Control	Automatic/OFF
Video Output	1 Vp-p, 75 ohms
Video Signal to Noise	> 50 dB
Presets	60 minimum
Wide Dynamic Range	128 X
Cable Type	Shielded Cat5E cable with Electrostatic Discharge (ESD) drain wire.

Cameras shall have power input circuitry designed to protect the internal electronics from damage from power surge and from under voltage conditions per the guidelines of IEEE C62.36-1991.

Cameras and lens combinations shall automatically recover from over and under voltage conditions, when the prime power is returned to values defined by the Specifications, by returning to the last position prior to the over/under voltage condition.

Lenses shall mechanically or electrically protect the motor from overrunning in extreme positions.

2.1.3.1.1.5.7 (B) Pan/Tilt Unit: Pan/tilt units shall be designed specifically for the environmental conditions that they will be subjected to while meeting the following minimum requirements:

Function/Feature	Minimum Requirement
Pan range	0° to 360°
Tilt range	10° up and 83° down from the horizontal axis
Pan/tilt minimum speed (manual)	40° pan/second and 20° tilt/second.
Presets	60 minimum

Pan/tilt units that pan or tilt at speeds in excess of 30 degrees/second shall have variable speed operation.

Pan/tilt units shall use housings that are corrosion resistant, rated NEMA 4 or better, and provide for feed through cabling.

Pan/tilt units shall have either adjustable worm gears drives or stepper motors that are capable of instantaneous reverse motor action, are corrosion resistant, do not require lubrication, and meet the following minimum requirements:

Description Minimum	Requirement
Allowable load (worm gear motor)	40 pounds
Allowable load (stepper motor)	20 pounds
Bearings	Heavy-duty ball or roller bearings.
Gears	Hardened steel.
Finish	Light color baked enamel or anodized.
Cabling	Internal feed through cabling.

2.1.3.1.1.5.8 Precision Pan/Tilt Units: Precision pan/tilt units shall meet the requirements stated for pan/tilt units except that they shall have stepper motors and stop on a programmed pan/tilt preset within an accuracy of one-fourth degree. The pan/tilt unit shall provide the remote user with variable pan and tilt speeds. The minimum rate of pan shall be 80 degree/second. The minimum rate of tilt shall be 40 degree/second.

2.1.3.1.1.6 Environmental Enclosure: Environmental enclosures shall be used to house the camera and lens. Environmental enclosures shall be sealed and corrosion resistant. The interface

with the pan/tilt unit shall be achieved in a manner that leaves no exposed cabling.

The environmental enclosure shall be equipped with a thermostatically controlled heater/fan.

The environmental enclosure shall have a corrosion resistant sun shield that covers the upper half of the enclosure. The sun shield shall permit air to freely circulate between the sun shield and the environmental enclosure.

Environmental enclosure shall be cylindrical in shape (or approved equal) not exceeding 5.2 inches outside diameter, or hemispherical dome no larger than 15 inches for the lower half.

The enclosure shall have an optically clear, impact resistant front window (for cylindrical enclosure) or dome acrylic lens (for dome enclosures). The front window or acrylic lens shall not yellow, introduce appreciable light loss, or distort over a 10-year service life when exposed to a desert environment.

2.1.3.1.1.6.1 Dome Enclosure: Either the upper or lower half of the dome enclosure shall be easy to remove without the use of tools.

2.1.3.1.1.6.2 A safety wire (or approved equivalent) shall be used to hold the removed half when disconnected. Bond the dome enclosure to mounting arm/bracket and ensure that the mounting arm/bracket is bonded to the CCTV pole or structure. It is preferred to have an exterior corrosion resistant pin connector that enables testing of the camera assembly within the dome without unsealing the dome.

2.1.3.1.1.7 Mounting: Provide all mounting equipment and adapter plates needed to securely mount the pan/tilt unit or dome assembly to the CCTV pole or other structure as required. Mounting shall comply with MCDOT Standard details or approved alternative drawings.

All dome cameras shall be mounted to the pole using a pendant arm and strapped to the pole using three-forth inch BAND-IT® type 201 stainless steel bands or approved equal. Straps utilizing a worm gear to tighten and hold the strap shall not be used.

2.1.3.1.1.7.1 CCTV Cabinet: Contractor will furnish and install a pole mounted Type G cabinet ("G" NEMA Controller Cabinet, TS 2 Type 1) for each CCTV location, per MCDOT Detail 2.1.25.

All equipment shall be mounted to the signal cabinet either by the use of a panel or din mount railings.

2.1.3.1.2 Cables

2.1.3.1.2.1 Cat5E cable shall comply with IMSA 20-1 specification requirements (latest revision).

2.1.3.1.2.2 Each pull box, cabinet, or conduit entry point shall have a minimum of six feet of cable slack.

2.1.3.1.2.3 Strain relief shall be used to hold the weight of the electrical, video, and data cables when they hang in a vertical, sloping or horizontal position. Contractor shall submit a proposed method of strain relief for approval by the engineer.

2.1.3.1.2.4 An 8 feet service loop is required at the top of the CCTV camera pole or signal pole. A cable grip shall be placed at the beginning and the end of the service loops to support the weight of the cable and the loop inside the pole.

2.1.3.1.2.5 Drilling of a one-inch hole into the signal pole to accommodate the cable is authorized for dome cameras.

2.1.3.1.2.6 A grommet shall be used at each hole to prevent the cable from being frayed or damaged.

2.1.3.1.2.7 There shall be no visible cables hanging from the pole or the CCTV Camera enclosure and mounting arm.

2.1.3.1.2.8 Install s ESD protection in /cabinet for) Cat5E POE cable between pole mounted and cabinet mounted CCTV equipment. Ground each ESD protection module to the traffic signal cabinet terminal block.

2.1.3.1.2.9 Wire, ground, and bond equipment shall be in accordance with Section 250-86 of the NEC.

2.1.3.1.2.10 Operating Temperature: -40 degrees Celsius to +85 degrees Celsius

2.1.3.1.2.11 Operation Environment: Outdoor use, out of direct weather (5 percent to 100 percent non-condensing)

2.1.3.1.3 Environmental

2.1.3.1.3.1 All electronic equipment installed in the field shall meet the minimum environmental requirements of NEMA Standards Publication No. TS-2, Section 2, Environmental Standards and Test Procedures, including, but not limited to:

2.1.3.1.3.1.1 Power Interruption;

2.1.3.1.3.1.2 Temperature and Humidity;

2.1.3.1.3.1.3 Transients, Power Service and Input Terminals;

2.1.3.1.3.1.4 Nondestructive Transient Immunity;

2.1.3.1.3.1.5 Vibration; and

2.1.3.1.3.1.6 Shock.

2.1.3.1.3.2 All equipment exposed to the environment shall be corrosion resistant and designed to withstand 80 mph winds with a 30 percent gust factor, and withstand the effects of sand, dust, and hose-directed water per the hose down test described in the latest edition of the NEMA Standards Publication 250. All connections shall be watertight.

2.1.3.1.3.3 Camera equipment shall meet the above environmental requirements, except that the camera assembly shall perform to the stated specifications over an ambient temperature range of -30 degrees Fahrenheit to +158-degree Fahrenheit.

2.1.3.1.4 Text Generation

2.1.3.1.4.1 Camera assemblies shall have the capability to generate and superimpose two lines of text on the video stream, one for camera ID text and one for preset text. Provide a minimum of 20 alphanumeric characters per line that are between 20 and 30 horizontal TV lines in height. Provide the remote user with the ability to enable, disable, and edit the text messages. Store text messages within the camera assembly using non-volatile memory.

2.1.3.1.4.2 Camera location ID text consists of a single, user defined text message that is unique to each camera location.

2.1.3.1.5 Maintenance Software Requirements

2.1.3.1.5.1 Provide software that can be used to provide local operation and full diagnostic support for each different camera assembly monitor.

2.1.3.1.5.2 During submittals, furnish a list of minimum requirements for the County maintenance laptop computers. If local software requires an operating system that is not offered by the County laptops, then furnish and install the necessary operating system including a start-up screen that allows the user to choose the appropriate operating system.

2.1.3.1.5.3 Software requirements will be waived if identical software is already loaded on the County's maintenance laptop computers, or if the CCR provides local operation and diagnostic capabilities.

2.1.3.2 Construction Requirements

2.1.3.2.1 Contractor shall set electrical or mechanical pan and tilt limit stops at positions determined by the engineer. Contractor shall program in camera location identification text labels obtained from the engineer.

2.1.3.2.2 The cables in the cabinet from device to device shall not be longer than required. The cables shall be routed for permanent installation and any excess will be cut to remove the slack. The only exception is the 6-foot slack at the cable entry point for the cabinet.

2.1.3.2.3 Contractor shall provide post installation pictures in electronic format of the mounted CCTV camera, the slack for each pull box, the CCTV ESD protection with ground wire, and the cabinet as part of the inspection. Each photo shall be clearly labeled with the photo location and equipment shown. Any discrepancies with the installation shall be resolved by the contractor.

2.1.3.3 Testing Requirements

2.1.3.3.1 Contractor shall demonstrate that the equipment and the systems furnished and installed under the contract function in full compliance with the requirements of the contract documents. Contractor shall furnish and maintain all required test equipment. Conduct tests in the presence of the engineer using approved test procedures and submit the test results to the engineer using approved test data forms. Engineer will review the test results for conformance with the requirements of the contract documents. If the equipment or systems fail any part of the test, the contractor shall make necessary corrections and repeat the entire test.

2.1.3.3.2 Notify the engineer of the time, date and place of all tests at least 14 calendar days prior to the date on which a test is planned.

2.1.3.3.3 Engineer may waive the right to witness certain tests.

2.1.3.3.4 Contractor shall ensure that all equipment to be tested is ready for testing prior to the performance of, and engineer's witnessing of the tests. Costs for transportation, meals, and lodging for the engineer and his representatives that are associated with delays in the testing will be deducted from monies due, or to become due, or owed to the contractor.

2.1.3.3.5 All test data forms shall be signed by the contractor or authorized representative.

2.1.3.3.6 When tests are witnessed by the engineer, the Con contractor tractor shall obtain the witnessing engineer‘s signature on the test data form.

2.1.3.3.7 The contract period will not be extended for time loss or delays related to testing.

2.1.3.3.8 Failure of any item to meet the requirements for any test will be counted as a defect and the equipment under test will be subject to rejection by the engineer. Rejected equipment may be re-tested provided all areas of non-compliance have been corrected and evidence thereof is submitted to the engineer by the contractor.

2.1.3.3.9 For equipment that has failed and subsequently been repaired or modified, the contractor shall prepare and deliver a report to the engineer that describes the nature of the failure and the corrective action taken. Re-design and modification of failed equipment shall be done at no additional cost.

2.1.3.3.10 Contractor shall conduct or support tests in the following stages of implementation:

2.1.3.3.10.1 Design Approval Test (DAT);

2.1.3.3.10.2 Factory Demonstration Test (FDT) (when required);

2.1.3.3.10.3 Factory Acceptance Test (FAT);

2.1.3.3.10.4 Stand-Alone Test;

2.1.3.3.10.5 Subsystem Test (SST);

2.1.3.3.10.6 Systems Integration Test (SIT) (when required); and

2.1.3.3.10.7 System Acceptance Test (SAT).

2.1.3.3.11 DAT verify that certain design parameters are satisfied prior to going to production.

2.1.3.3.12 FDT are performed on a production unit and verify that the equipment meets the functional requirements. FAT verify that each unit of equipment as it comes off the production line operates as specified. Stand-alone tests verify that after installation but prior to interconnection, the equipment operates as specified. SSTs verify that units forming a subsystem continue to operate as specified when they are interconnected.

2.1.3.3.13 Design Approval Tests (DAT)

2.1.3.3.13.1 A DAT shall be conducted when required by the Specifications. Contractor shall provide certification from the manufacturer for the following:

2.1.3.3.13.1.1 The equipment has been laboratory tested and meets or exceeds the environmental requirements of the Specifications. Specifically list test results and passing criteria for each required test.

2.1.3.3.13.1.2 The equipment meets the functional requirements stated in the Specifications (See Section 2.0) and is suitable for the intended application. The certification shall state any requirements that are not met or have not been laboratory tested. Test procedures and results, or

independent laboratory certification shall be made available upon request.

2.1.3.3.13.2 DAT certification shall meet the requirements stated in Section 2.1.3.1.1 for Certificates of Compliance. If a Design Approval Test (DAT) and a Certificate of Compliance is required for the same equipment, both requirements may be satisfied by a single Certificate of Compliance.

2.1.3.3.13.3 Submit DAT certification with the equipment submittal data for engineer's approval.

2.1.3.3.13.4 Engineer may waive the DAT requirement for equipment that has been previously tested by the MCDOT or certified for use in prior projects where the application is consistent and results deemed favorable.

2.1.3.3.13.5 Contractor should contact MCDOT for information regarding the DAT or certification status of a particular device.

2.1.3.3.13.6 Provide DAT certification for the camera, lens, pan/tilt unit, environmental enclosure, and camera control receiver for equipment the contractor desires to have as an approved equal.

2.1.3.3.14 Factory Demonstration Tests (FDT)

2.1.3.3.14.1 A FDT shall be conducted when required by the Specifications. A FDT shall be conducted on a prototype model before going to production. The FDT requirement for models of equipment previously tested and/or certified by the MCDOT for the types of applications required in the project may be waived by the engineer.

2.1.3.3.14.2 To gain a waiver, the contractor shall submit certification from the manufacturer that states that the equipment has been tested and meets all the project requirements.

2.1.3.3.14.3 State any exceptions or requirements not covered by testing. Provide supporting information such as test procedures, data, and results.

2.1.3.3.14.4 Costs for lodging and transportation for the engineer and his representatives to witness the FDT, will be borne by MCDOT, for one visit lasting for up to five consecutive days. In the event, the FDT requires multiple visits by the engineer or lasts longer than five consecutive days, the contractor shall be

responsible for the added cost of transportation and lodging beyond what is covered by the County.

2.1.3.3.15 Factory Acceptance Tests (FAT)

2.1.3.3.15.1 A FAT shall be conducted on each unit of equipment. The FAT shall verify proper operation of all required functions. The contractor shall submit FAT results for approval and shall not deliver equipment until FAT results have been approved by MCDOT.

2.1.3.3.16 Stand-Alone Tests

2.1.3.3.16.1 The stand-alone test verifies after installation, but prior to connection to the system, that the equipment can perform the function for which it was designed. Contractor shall conduct approved stand-alone tests on each equipment group that performs a specific function. Testing is to use the manufacturer's approved software after the on-site installation of the equipment group is completed. Contractor shall furnish all necessary test equipment and test software.

2.1.3.3.16.2 For each unit of equipment, conduct approved stand-alone tests that exercise all stand-alone (non-network) functional operations of the equipment including the following:

2.1.3.3.16.2.1 Control of focus, iris, and power on/off;

2.1.3.3.16.2.2 Range of pan, tilt, zoom and digital zoom;

2.1.3.3.16.2.3 Presence and quality of video signal;

2.1.3.3.16.2.4 Camera ID and preset text generation; and

2.1.3.3.16.2.5 Pan and tilt limit stops are set to the engineer's specification.

2.1.3.3.16.3 The CCTV camera assembly shall be bench tested for no-less-than 24 hours as a unit to include the CCTV camera, all cabling, all surge suppression, and Video Encoder. Refer to Sections 2.1.3.1.1, 2.1.3.1.2, 2.1.3.1.3, 2.1.3.1.4, and 2.1.3.1.5. Contractor shall request the active electronics configuration information from the engineer prior to the 24-hour bench test.

2.1.3.3.16.4 After the 24-hour bench test the contractor shall notify the engineer that the system is ready for the pre-inspection. Engineer will schedule the ITS Inspector to conduct the pre-inspection at the contractor's facility.

2.1.3.3.16.5 The ITS Inspector will inspect the camera system on the reel using the pre-installation CCTV Local Field Operations Test.

2.1.3.3.16.6 After the completion of the pre-installation CCTV Local Field Operations Test the contractor shall submit the pre-inspection test and the CCTV Camera installation plan to the engineer. The installation plan shall consist of the camera location, estimated cable lengths, cable route, cable slack, wiring diagram, and camera configuration.

2.1.3.3.16.7 Once the installation plan is approved by the engineer, the ITS Inspector will be scheduled to meet with the contractor onsite for installation. The ITS inspector will be present for all stages of the camera installation.

2.1.3.3.17 Subsystem Tests (SST)

2.1.3.3.17.1 SST verify that units forming a subsystem continue to operate as specified when they are interconnected. A subsystem is defined as a logical grouping of field devices and/or central equipment that when interconnected and communicating, is capable of performing the function for which it was designed (i.e. – CCTV cameras, communications to/from the cameras, central control and display of the video images). Contractor shall conduct approved SST for the field equipment and related equipment at the hubs and the Traffic Management Center (TMC). Conduct SST on the groups of equipment as identified in the project special provisions after the equipment has been installed and interconnected.

2.1.3.3.17.2 Subsystem tests shall not be considered successful until all equipment being tested is operational without failure for 72 consecutive hours.

2.1.3.3.17.3 For each camera location that is installed and interconnected in a system, the contractor shall conduct approved SST from a workstation at the Traffic Management Center that includes the following:

2.1.3.3.17.3.1 All items in the stand-alone test;

2.1.3.3.17.3.2 Transmission of quality video to the Traffic Management Center;

2.1.3.3.17.3.3 Response to all central software commands identified under functional requirements;

2.1.3.3.17.3.4 Horizontal and vertical resolution and

2.1.3.3.17.3.5 Signal to noise (S/N) ratio of 48 dB or greater.

2.1.3.3.17.4 Perform these tests if in the opinion of the engineer the picture quality is substandard. Measure the horizontal/vertical resolution and the S/N ratio on a monitor in the Traffic Management Center for a picture generated by the CCTV camera installation furthest from the Traffic Management Center and at two other locations specified by the engineer to verify compliance.

2.1.3.3.18 System Integration Test (SIT)

2.1.3.3.18.1 The SIT is performed when previously untested hardware or software is developed and/or added to an existing system to verify that all system interfaces perform properly prior to final acceptance. The duration of the SIT shall be based on the complexity of the design. The SAT verifies that all the interconnected subsystems operate together as one system. Upon successful completion and acceptance of the SAT, the project will advance to the warranty and operational support period. Contractor shall begin the SIT upon completion of all the SSTs. Contractor is responsible to keep the installed equipment operational during the system final integration as determined by the engineer. Contractor shall identify the SIT in the project schedule. Contractor shall work with the engineer to troubleshoot all problems related to non-specification compliant equipment and interfaces.

2.1.3.3.19 System Acceptance Test (SAT)

2.1.3.3.19.1 The SAT verifies that all the interconnected subsystems operate together as one system. The SAT may commence upon completion of the SIT. The SAT consists of a 30-day test period demonstrating that the total system (hardware, software, materials and construction) is properly installed, is free from

identified problems, exhibits stable and reliable performance, and complies with the contract documents.

2.1.3.3.19.2 Contractor shall demonstrate all system functions using live control equipment.

2.1.3.3.19.3 Test all normal and backup functions of redundant system equipment and include in the SAT any emergency conditions for which the equipment is designed to respond.

2.1.3.3.19.4 Contractor shall troubleshoot, diagnose, identify, and isolate hardware and software problems and inconsistencies. Formulate possible solutions and implement all corrections needed for the contractor installed equipment.

2.1.3.3.19.5 Contractor shall make available on-site, key technical personnel familiar with the design and construction of each major system component within 48 hours of notification of a problem.

2.1.3.3.19.6 Contractor shall correct all system documentation errors, omissions, and changes discovered and resulting from the SAT and previous testing. System acceptance will not be complete until corrected documentation is submitted.

2.1.3.3.19.7 In the event of a failure of a single piece of equipment during the SAT, the contractor shall replace or repair the equipment and restart the 30-day test only for that piece of equipment. If the failure of the single piece of equipment prevents the proper operation of other equipment (e.g. – failure of the video encoder prevents proper camera control), all devices affected by the failure will have the test extended by however many days they were out of service.

2.1.3.3.19.8 The following conditions constitute a minor system failure and will result in a suspension of time during the 30-day SAT. After satisfactory remedial action, the 30-day test will be resumed and extended one additional day:

2.1.3.3.19.8.1 Interference with project operations due to vandalism, traffic accident, power failure, or lightning for which lightning protection devices as specified are not sufficient protection;

2.1.3.3.19.8.2 Failure to complete the objective of any test scenario due to lack of adequate documentation for equipment supplied by the contractor. Contractor shall re-test using revised documentation; and

2.1.3.3.19.8.3 Intermittent hardware, software, communication, or operation control malfunctions.

2.1.3.3.19.9 The following constitutes a major system failure. Any one of the following conditions shall result in re-initialization of the SAT from day zero:

2.1.3.3.19.9.1 Failure of five percent of any hardware or performance item within a 14-day period; and

2.1.3.3.19.9.2 Failure to correct any problem that adversely impacts the safety of the traveling public, the engineer, or his representatives within four hours of notification.

2.1.3.3.20 Test Procedures, Software, and Data Forms

2.1.3.3.20.1 Contractor shall prepare test procedures, software (when needed) and data forms for all required DAT, FDT, FAT, stand-alone, SST, and SAT procedures.

2.1.3.3.20.2 Submit test procedures, software, and data forms to the engineer for approval at least 45 calendar days before the scheduled testing. Engineer will review the submitted procedures, software, and data forms and return them within 14 calendar days after receipt. If approved, tests may be conducted as scheduled. If rejected, reschedule the test, revise the submittal accordingly and resubmit for another review. Highlight the portions of the submittal that have changed to aid the engineer's re-review of the material. Extension of the schedule will not be granted for rejected test procedures, software, and data forms.

2.1.3.3.20.3 As a minimum, prepare test procedures and data forms that include the following:

2.1.3.3.20.3.1 A step-by-step outline of the test sequence to be followed, showing a test of every function of the equipment or system to be tested;

2.1.3.3.20.3.2 A description of the expected operation, pass/fail criteria, and test results;

2.1.3.3.20.3.3 A data form to be used to record all data and quantitative results obtained during the test; and

2.1.3.3.20.3.4 A description of any special equipment, setup, manpower, or conditions required for the test.

2.1.3.4 Warranty Requirements

2.1.3.4.1 If specific warranty requirements apply, they are listed under specific equipment requirements of the specifications. The cost of warranties and repairs are included as part of the contract unit price.

2.1.3.4.2 Within 60 days following approval of material and equipment, the contractor shall submit a preliminary Warranty Administration Plan (WAP) to the engineer for approval.

2.1.3.4.3 The WAP is to address how the warranty period shall be administered, including the following requirements:

2.1.3.4.3.1 24/7/365 telephone number for MCDOT initiated warranty requests;

2.1.3.4.3.2 Repair or replace failed items that prevent normal operation of the system or any of the subsystems within five calendar days after notification. Respond to all other warranty requests within fourteen calendar days;

2.1.3.4.3.3 Track each repair performed during the warranty period by serial number. Account for removals, replacements, and repaired items put back in service or into the spare inventory. Reset the warranty period for all repaired or replaced items. Establish a new warranty period for all new items;

2.1.3.4.3.4 Perform routine maintenance during the warranty period per vendor recommendations.

2.1.3.4.3.5 Provide a summary of all routine maintenance activities required, whether or not they fall within the one-year warranty period;

2.1.3.4.3.6 When used, replenish spare equipment inventory within two weeks, or stated vendor lead-time, whichever is greater;

2.1.3.4.3.7 Provide a complete list of equipment and vendor warranty periods, including spare equipment. Use Figure 2.1.3.4 or similar approved form; and

2.1.3.4.3.8 Provide copies of all warranty paperwork.

2.1.3.4.4 Submit a final WAP to the engineer for approval at least 45 days prior to final acceptance. An approved WAP is required prior to final acceptance.

2.1.3.4.5 Prior to final acceptance, furnish an inventory of spare parts.

2.1.3.4.6 Within 90 days and no later than 30 days prior to the end of the one-year warranty period, submit the following to the engineer for approval:

2.1.3.4.6.1.1 A complete list of all equipment (by serial number) that have warranties extending beyond the one-year warranty period, including spare equipment. Use Figure 2.1.3.4 or similar approved form; and

2.1.3.4.6.1.2 All warranty paperwork extending beyond the one-year period, transferring ownership of the warranties to MCDOT.

2.1.3.4.7 The front window (cylindrical enclosure) or acrylic lens (dome enclosure) shall have a five-year warranty against yellowing, appreciable light loss, or distortion. The camera assembly, cables, and camera panel system as a whole shall have a minimum five-year warranty.

Figure 2.1.3.4 Equipment Warranties

Project Name Equipment Warranties Submitted By: Date:			Project No.: Federal Project No.:			
Serial #	Description	Location	Warranty Duration	Expiration Date	Date Received	Other Information

2.1.3.5 Documentation

2.1.3.5.1 Deliver a minimum of two sets of maintenance manuals to the engineer for all furnished equipment. The manuals shall be supplied in durable, loose-leaf, three ring binders of appropriate size. All sections shall be permanently titled and have pages numbered and indexed for easy and efficient removal and replacement. In addition, an electronic copy of all manuals shall be provided for all equipment and software.

2.1.3.5.2 Format maintenance manuals in two sections that include the following material for all furnished equipment and components:

2.1.3.5.3 Section 1

2.1.3.5.3.1 Description for each type of equipment and its components.

2.1.3.5.3.2 Description of operation.

2.1.3.5.3.3 Troubleshooting procedures at system and device levels.

2.1.3.5.3.4 Preventative maintenance and adjustment procedures.

2.1.3.5.3.5 “As-built” drawings including block diagrams, signal path, and detailed device and system connection diagrams (reference Section 2.1.8.2.3).

2.1.3.5.3.6 Equipment source reference including manufacturer and nearest authorized service centers along with associated addresses and telephone numbers.

2.1.3.5.3.7 Final warranty administration plan.

2.1.3.5.4 Section 2

2.1.3.5.4.1 Manufacture’s operation and installation.

2.1.3.5.4.2 Manufacture’s service and repair guides.

2.1.3.5.5 Contractor shall provide maintenance manuals for CCTV equipment per the above requirements, including the following diagrams (as appropriate):

2.1.3.5.5.1 Video system block diagram showing all components;

2.1.3.5.5.2 Video signal path diagram;

2.1.3.5.5.3 Control signal path diagram;

2.1.3.5.5.4 System connection diagram; and

2.1.3.5.5.5 Detailed connection diagrams.

2.1.3.6 Training

2.1.3.6.1 When required, training shall be provided in two sessions.

2.1.3.6.2 The first training session shall be for maintenance and troubleshooting. This session shall be a minimum of four hours in length for each type of field device installed, including communications. This session shall be oriented for the County maintenance staff.

2.1.3.6.3 The second training session shall be for operations. This session shall be a minimum of four hours in length for each type of field device installed. This session shall be oriented for the County Traffic Management staff.

2.1.3.7 Measurement

2.1.3.7.1 CCTV camera assembly, including the camera, lens, pan/tilt, camera control receiver, sun shield, environmental enclosure, , cables, lightning and Electrostatic Discharge (ESD) protection, and any other required accessories, will be measured as a unit for each installed.

2.1.3.7.2 CCTV cabinets will be measured as a unit for each type installed.

2.1.3.7.3 Testing, warranty, documentation, and training are considered incidental to the item requiring the work.

2.1.3.8 Payment

2.1.3.8.1 The accepted quantities of items, measured as above, will be paid for at the contract unit price, COMPLETE IN PLACE, which price shall be full compensation for the work described. COMPLETE IN PLACE, including all equipment described under this item with all cables and connectors; all documentation and testing, including the cost of furnishing all labor, materials, software, warranty, training, and equipment necessary to complete the work.

2.1.4 Radio Communications Equipment

The work under this section shall consist of furnishing, installing, and testing communications equipment systems including, cabinet, cables, mounting, ESD protection, surge suppression, lightning protection, software, and accessories as indicated.

2.1.4.1 Materials and Equipment Requirements

2.1.4.1.1 Wireless Ethernet Transceivers: The Ethernet Point to Point (PTP) and Point to Multipoint (PMP) radio equipment shall provide a high reliability, bi-directional, multi-point, multi-platform communication link between field devices and the MCDOT ITS network. .

Electronic equipment and POE power supply shall meet the minimum requirements of National Electric Manufacturers Association (NEMA) Standards Publications No. TS-2, Section 2 Environmental Standards and Test Procedures. Contractor shall provide step-up/step-down transformers and Alternating Current (AC) to Direct Current (DC) power conversion as needed to match the power requirements of each component.

2.4GHz and 5.8GHz Radios shall be Ubiquity Nano-Station M5 or equivalent

2.1.4.1.1.1 Functional Requirements: The Wireless Ethernet Transceiver equipment shall meet the following requirements.

2.1.4.1.1.1.1 Operate in both the licensed and unlicensed bands: 2.3 Gigahertz (GHz), 2.5 GHz, 4.9 GHz, and 5.25 - 5.825 frequency ranges

2.1.4.1.1.1.2 Provide a max modulation of 54 Megabytes per second (Mbps) for unlicensed frequencies and 40 Mbps for licensed frequencies

2.1.4.1.1.1.3 Modular architecture that can support from two to four radios for communication nodes and up to two radios for backhaul or end nodes

2.1.4.1.1.1.4 Operating modes of Point-to-point, Point-to-Multipoint, and Multipoint-to-Multipoint completely configurable via a web interface, command line interface (CLI), and software

2.1.4.1.1.1.5 Software to provide: remote diagnostics, remote maintenance, and spectrum analyzer

2.1.4.1.1.1.6 Radio shall support any combination of roles such as Access Radio, Backhaul Radio, and WiMax Radio

2.1.4.1.1.1.7 Provide Layer 2 and Layer 3 Switch Router functionality

2.1.4.1.1.1.8 Operating temperature of -40 degrees Celsius to +50 degrees Celsius

2.1.4.1.1.1.9 Programmable for Radio Frequency (RF) output levels of 1 Milliwatt (mW), 10mW, or 100mW

2.1.4.1.1.2 The Ethernet radio equipment shall comply with the following Institute of Electrical and Electronics Engineers (IEEE) Standard Specifications.

2.1.4.1.1.2.1 IEEE 802.3i: 10BASE-T

2.1.4.1.1.2.2 IEEE 802.3u: 100BASE-TX, 100BASE-FX

2.1.4.1.1.2.3 IEEE 802.1d: MAC Bridging

2.1.4.1.1.2.4 IEEE 802.1Q: VLANs

2.1.4.1.1.2.5 IEEE 802.1p: Prioritization

2.1.4.1.1.2.6 IEEE 802.1x: Radius

2.1.4.1.1.2.7 RFC768: UDP

2.1.4.1.1.2.8 RFC791: IP

2.1.4.1.1.2.9 RFC792: ICMP

2.1.4.1.1.2.10 RFC793: TCP

2.1.4.1.1.2.11 RFC826: ARP

2.1.4.1.1.2.12 RFC854: Telnet

2.1.4.1.1.2.13 RFC894: IP over Ethernet

2.1.4.1.1.2.14 RFC959: FTP

2.1.4.1.1.2.15 RFC1112: IGMP v1

2.1.4.1.1.2.16 RFC1157: SNMP

2.1.4.1.1.2.17 RFC1350: TFTP

2.1.4.1.1.2.18 RFC1541: DHCP (client)

2.1.4.1.1.2.19 RFC2030: SNTP

2.1.4.1.1.2.20 RFC2068: HTTP

2.1.4.1.1.2.21 RFC2236: IGMP v2

2.1.4.1.1.3 (B) Physical Requirements

2.1.4.1.1.3.1 One 10/100 Mbps Ethernet port

2.1.4.1.1.3.2 One 100Base-FX Ethernet Interface (SMFO)

2.1.4.1.1.3.3 LED indicators for radio communications: PWR, TX DATA, RX DATA

2.1.4.1.1.3.4 LED indicators for network communications: 10 Mbps, 100 Mbps, and Activity

2.1.4.1.1.3.5 The radio shall comply with IP56, NEMA4, and NEMA4X for wet and dusty conditions

2.1.4.1.1.4 All system components shall provide for a fully functional operation. The spread spectrum assembly shall include all communication equipment and accessories necessary to support the Ethernet radio site that provides transmitting, receiving, and repeating (for extending range beyond line of sight to the first cabinet on the drop) capabilities for point-to-point, point-to-multipoint, and multipoint-to-multipoint bi-directional configurations.

2.1.4.1.1.5 Ethernet radio shall operate within the licensed and unlicensed bands of 2.3 GHz, 2.5 GHz, 4.9 GHz, and 5.25-5.825 GHz frequency range. The unit shall also support an Ethernet interface. The unit shall be FCC certified.

Radio	Frequency	Transmit Power	Receive Sensitivity	Channel Size
Access Radio	2.4Ghz to 5.8Ghz	Up to 27.6 dBm	-100 dBm (DSSS) -94 dBm (OFDM)	20 MHz
Backhaul Radio		17 dBm (48, 54 Mbps)	-90 dBm @ 6 Mbps	20 MHz
Backhaul Radio	2.4Ghz to 5.8Ghz	17 dBm (48, 54 Mbps)	-90 dBm @ 6 Mbps -71 dBm @ 54 Mbps	20 MHz
Backhaul Radio	2.4Ghz to 5.8Ghz	17 dBm (48, 54 Mbps)	-90 dBm @ 6 Mbps -71 dBm @ 54 Mbps	20 MHz
Backhaul Radio	2.4Ghz to 5.8Ghz	17 dBm (48, 54 Mbps)	-90 dBm @ 6 Mbps -71 dBm @ 54 Mbps	20 MHz
Backhaul Radio	2.4Ghz to 5.8Ghz	17 dBm (48, 54 Mbps)	-90 dBm @ 6 Mbps -71 dBm @ 54 Mbps	20 MHz
WiMax Radio	2.4Ghz to 5.8Ghz	12 dBm @ 10 MHz	-93 dBm @ 6 Mbps	10 MHz

WiMax Radio	2.4Ghz to 5.8Ghz	12 dBm @ 10 MHz	-93 dBm @ 6 Mbps	10 MHz

2.1.4.1.1.6 Cabling shall be 10/100 Mbps Ethernet connectivity for the transceiver. All Ethernet cable shall be Ubiquity Tough Cable Cat5E or approved equal with the specifications of CAT5e, outdoor rated, waterproof, , foil + braid shielding and black outer jacket.

2.1.4.1.1.7 Installed cables shall be labeled and fastened in an appropriate manner to portray a professional and neat appearance.

2.1.2.4 Measurement

2.1.2.5.1 Communications equipment systems will be measured as a unit for each type furnished, installed, and accepted complete in place. Items such as cables, mounting, excavation, surge suppression, lightning protection, ESD protection local software, and various accessories as needed are included as part of the system.

2.1.2.5.2 Radios shall be measured by each type furnished, installed, and accepted complete in place.

2.1.2.6 Payment

2.1.2.6.1 The accepted quantity of items will be paid for at the contract unit price which shall be full compensation for the work described including testing, warranty, documentation, and training.

2.1.5 Adaptive Signal Control Technology (ASCT) Equipment

The work under this section shall consist of furnishing, installing, and testing ASCT equipment which may include, but is not limited to surge protection, Power Over Ethernet (PoE) injector, PoE extender, equipment panel, processor, cameras, software, warranty support, and various accessories as needed to be functional in place.

2.1.5.1 Material Requirements

2.1.5.1.1 Camera

2.1.5.1.2 Environmental

2.1.5.1.2.1 All electronic equipment installed in the field shall meet the minimum environmental requirements of NEMA Standards, NEMA-4X, IP66 rated, Environmental Standards and Test Procedures, including, but not limited to:

2.1.5.1.2.1.1 Power Interruption;

2.1.5.1.2.1.2 Temperature and Humidity;

2.1.5.1.2.1.3 Transients, Power Service and Input Terminals;

2.1.5.1.2.1.4 Nondestructive Transient Immunity;

2.1.5.1.2.1.5 Vibration; and

2.1.5.1.2.1.6 Shock;

2.1.5.1.2.1.7 Day/Night Vision

2.1.5.1.2.1.8 H.264 video compression

2.1.5.1.2.1.9 All equipment exposed to the environment shall be corrosion resistant and designed to withstand 80 mph winds with a 30 percent gust factor, and withstand the effects of sand, dust, and hose-directed water per the hose down test described in the latest edition of the NEMA Standards Publication 250. All connections shall be watertight.

2.1.5.1.2.1.10 Camera equipment shall meet the above environmental requirements, except that the camera assembly shall perform to the stated specifications over an ambient temperature range of -40 degrees Fahrenheit to +165 degrees Fahrenheit.

2.1.5.1.3 Processor

The processor equipment shall be shelf or DIN-rail mountable and include necessary NEMA standard cabling for communication with existing traffic control equipment. The processing unit shall be capable of operating as a stand-alone system for data storage and management, providing data archiving and historical data queries. The processor shall be compatible with all existing MCDOT ITS traffic signal controllers, selected detection systems, current adaptive systems, and TMC equipment.

2.1.5.1.3.1 Environmental: All electronic equipment installed in the field shall meet the below minimum environmental requirements of NEMA Standards Publication No. TS-2, Section 2, Environmental Standards and Test Procedures, including, but not limited to:

2.1.5.1.3.1.1 Operating Temperature: -40 degrees Fahrenheit to +165 degrees Fahrenheit (-

40 degrees Celsius to +74 degrees Celsius)

2.1.5.1.3.1.2 Storage Temperature: -50 degrees Fahrenheit to +185 degrees Fahrenheit (-45.5 degrees Celsius to +85 degrees Celsius)

2.1.5.1.3.1.3 Humidity: 5~90 percent @ 45 degrees Celsius, (non-condensing)

2.1.5.1.3.1.4 Vibration: 3 grams/5~500Hz/random operation

The processor shall be fanless and compact, fit well in confined spaces, have flexible mounting, high resistance to vibration and shock, be compatible with various Input/Output requirements, be integrable with a variety of smart applications have front removable drive bay for HDD/SSD, and provide over/under/reverse voltage protection.

2.1.5.1.3.2 Equipment Panel

The equipment panel shall provide power and communication for the ASCT system equipment and provided fuse protection for camera power leads. The equipment panel mounting shall have flexible mounting options including the use of existing vertical “C” channels in the cabinet. The equipment panel shall include the following features: hardened 120 VAC to 24 VDC 600-watt power supply, 100 Mbps unmanaged Ethernet switch, 8 Ethernet networking ports, DC/DC terminal blocks for camera power, earth ground bar, lightning arrestors, and fuse block.

2.1.5.1.3.2.1 Environmental: All electronic equipment installed in the field shall meet the minimum environmental requirements of NEMA Standards Publication No. TS-2, Section 2, Environmental Standards and Test Procedures, including, but not limited to:

2.1.5.1.3.2.1.1 Power Interruption;

2.1.5.1.3.2.1.2 Temperature and Humidity;

2.1.5.1.3.2.1.3 Transients, Power Service and Input Terminals;

2.1.5.1.3.2.1.4 Nondestructive Transient Immunity;

2.1.5.1.3.2.1.5 Vibration; and

2.1.5.1.3.2.1.6 Shock.

The equipment panel shall meet the above environmental requirements, except that the assembly shall perform to the stated specifications over an ambient temperature range of -40 degrees Fahrenheit to +165 degrees Fahrenheit.

2.1.5.2 Construction Requirements

2.1.5.2.1 The contractor shall coordinate with MCDOT engineer or assigned representative for specific locations. Contractor shall install the device according to manufacturing guidelines with the approval of MCDOT engineer or assigned representative. Contractor shall include cables and additional components as necessary for ASCT requirements. The cables in the cabinet from device to device shall not be longer than required. The cables shall be routed and fastened for permanent installation.

2.1.5.3 Testing Requirements

2.1.5.3.1 Contractor shall demonstrate that the equipment and the systems furnished and installed under the contract functions in full compliance with the requirements of the contract documents.

2.1.5.4 Warranty Requirements

2.1.5.4.1 Contractor shall provide a minimum two-year hardware warranty.

2.1.5.4.2 Contractor shall provide two-year software warranty with new systems, with annual software warranty renewal options at contract unit pricing.

2.1.5.4.3 Contractor shall provide one-year 24/7/365 Technical support for new systems with annual renewal options at contract unit pricing.

2.1.5.5 Documentation

2.1.5.5.1 Deliver a minimum of two sets of maintenance manuals to the engineer for all furnished equipment.

2.1.5.5.2 Contractor shall provide maintenance manuals for ASCT equipment, including the following diagrams (as appropriate):

2.1.5.5.2.1 System block diagram showing all components;

2.1.5.5.2.2 Video signal path diagram;

2.1.5.5.2.3 System connection diagram; and

2.1.5.5.2.4 Detailed connection diagrams.

2.1.5.6 Training

2.1.5.6.1 When required, training shall be provided in two sessions.

2.1.5.6.2 The first training session shall be for maintenance and troubleshooting. This session shall be a minimum of four hours in length. This session shall be oriented for the County maintenance staff.

2.1.5.6.3 The second training session shall be for operations. This session shall be a minimum of four hours in length. This session shall be oriented for the County Traffic Management staff.

2.1.5.7 Measurement

2.1.5.7.1 ASCT equipment, including but not limited to the processor, camera, equipment panel, power supply, cabling, software, surge protection, and any other required accessories, will be measured as a unit for each installed.

2.1.5.7.2 Testing, warranty, documentation, and training are considered incidental to the item requiring the work.

2.1.5.8 Payment

2.1.5.8.1 The accepted quantities of items, measured as above, will be paid for at the contract unit price, COMPLETE IN PLACE, which price shall be full compensation for the work described. COMPLETE IN PLACE, including all equipment described under this item with all cables and connectors; all documentation and testing, including the cost of furnishing all labor, materials, software, warranty, training, and equipment necessary to complete the work.

2.1.6 Traffic Data Collection Equipment

The work under this section shall consist of furnishing, installing, and testing Traffic Data Collection equipment which shall include a sensor, cable connector, cabinet

device, surge protection, software, communication device, and various accessories as needed.

2.1.6.1 Material Requirements

2.1.6.1.1 Traffic Device Counter System

2.1.6.1.1.1 Environmental: All electronic equipment installed in the field shall meet the minimum environmental requirements of NEMA Standards Publication No. TS-2, Section 2, Environmental Standards and Test Procedures, including, but not limited to:

2.1.6.1.1.1.1 Power Interruption;

2.1.6.1.1.1.2 Temperature and Humidity;

2.1.6.1.1.1.3 Transients, Power Service and Input Terminals;

2.1.6.1.1.1.4 Nondestructive Transient Immunity;

2.1.6.1.1.1.5 Vibration; and

2.1.6.1.1.1.6 Shock.

All equipment exposed to the environment shall be corrosion resistant and designed to withstand 80 mph winds with a 30 percent gust factor, and withstand the effects of sand, dust, and hose-directed water per the hose down test described in the latest edition of the NEMA Standards Publication 250. All connections shall be watertight.

Traffic Data Collection equipment shall meet the above environmental requirements, except that the sensor assembly shall perform to the stated specifications over an ambient temperature range of -30 degrees Fahrenheit to +158 degrees Fahrenheit.

2.1.6.1.2 Traffic Data Collection system shall be a Wavetronix Solar XP20 Count Station or equivalent.

2.1.6.1.2.1 Sensor Mounting Bracket

2.1.6.1.2.2 Radar Sensor

2.1.6.1.2.3 Port DC Powered Arc

2.1.6.1.2.4 Link Cable

2.1.6.1.2.5 Solar Array (with cabinet)

2.1.6.1.2.6 Adjustable pole mount with 120-watt Solar array, prewired

2.1.6.2 Construction Requirements

2.1.6.2.1 Contractor shall coordinate with MCDOT engineer or assigned representative for specific locations.

2.1.6.2.2 Contractor shall install the device according to manufacturing guidelines with the approval of MCDOT engineer or assigned representative.

2.1.6.3 Testing Requirements

2.1.6.3.1 Contractor shall demonstrate that the equipment and the systems furnished and installed under the contract function in full compliance with the requirements of the contract documents.

2.1.6.4 Warranty Requirements

2.1.6.4.1 Contractor shall provide a minimum two-year hardware warranty.

2.1.6.5 Documentation

2.1.6.5.1 Deliver a minimum of two sets of maintenance manuals to the engineer for all furnished equipment.

2.1.6.5.2 Contractor shall provide maintenance manuals for equipment, including the following diagrams (as appropriate):

2.1.6.5.2.1 System block diagram showing all components.

2.1.6.5.2.2 System connection diagram; and

2.1.6.5.2.3 Detailed connection diagrams.

2.1.6.6 Training

2.1.6.6.1 When required, training shall be provided in two sessions.

2.1.6.6.2 The first training session shall be for maintenance and troubleshooting. This session shall be a minimum of four hours in length. This session shall be oriented for the County maintenance staff.

2.1.6.6.3 The second training session shall be for operations. This session shall be a minimum of four hours in length. This session shall be oriented for the County Traffic Management staff.

2.1.6.7 Measurement

2.1.6.7.1 Traffic Data Collection equipment shall include but not be limited to sensor, cable connector, cabinet device, surge protection, software, communication device, including any other required accessories, and will be measured as a unit for each installed.

2.1.6.7.2 Testing, warranty, documentation, and training are considered incidental to the item requiring the work.

2.1.6.8 Payment

2.1.6.8.1 The accepted quantities of items, measured as above, will be paid for at the contract unit price, COMPLETE IN PLACE, which price shall be full compensation for the work described. COMPLETE IN PLACE, including all equipment described under this item with all cables and connectors; all documentation and testing, including the cost of furnishing all labor, materials, software, communication, warranty, training, equipment necessary to complete the work or any other incidental non-equipment pricing.

2.1.7 ITS Network Equipment

2.1.7.1 The work under this section shall consist of furnishing, installing, and testing ITS network equipment systems including, router, switch, communications module, and accessories as indicated.

2.1.7.2 Contractor shall submit an original or copy of a Certificate of Compliance along with required equipment lists and supporting material, including warranty information to the engineer for approval as part of the material and/or equipment list.

2.1.7.3 If requested by the engineer, the contractor shall furnish laboratory results or independent certifications that substantiate compliance with the stated requirements.

2.1.7.4 Materials or equipment covered by the certificate may be sampled and tested at any time, and, if found not in conformity with the requirements of the project plans or specifications, will be subject to rejection, whether in place or not.

2.1.7.5 Certificate of Compliance shall contain the following information:

2.1.7.5.1 A description of the material or equipment supplied;

2.1.7.5.2 Means of material identification, such as label, lot number, or marking;

2.1.7.5.3 Statement that the material complies in all respects with the requirements of these Specifications. When identified in the Specifications, Certificates shall state compliance to specific cited standards, such as RUS 1755.900, NEMA TS-2, etc. and specific required tests, such as burn-through testing for fiber optic conduit;

2.1.7.5.4 Clearly state any exceptions to the requirements of the Specifications; and

2.1.7.5.5 The name, title, and signature of a person having legal authority to bind the manufacturer or the supplier of the material. The date of the signature shall also be given. The name and address of the manufacturer or supplier of the material shall be shown on the certificate. A copy or facsimile reproduction (FAX) will be acceptable; however,

the original certificate shall be made available upon request. The person signing the certificate shall be in one of the following categories:

2.1.7.5.5.1 An officer of a corporation.

2.1.7.5.5.2 A partner in a business partnership or an owner.

2.1.7.5.5.3 A general manager.

2.1.7.5.5.4 Any person having been given the authority in writing by one of the three listed above.

2.1.7.6 Certify that all functional requirements listed herein for hardware, software, and communication protocols are met.

2.1.7.7 General Functional Requirements: The network equipment shall interface with a combination of T1 leased lines, fiber, Ethernet, wireless, and/or EIA-232 devices to provide communications service to the MCDOT Traffic Management Center (TMC).

Electronic equipment and power supply shall meet the minimum requirements of NEMA Standards Publications No. TS-2, Section 2 Environmental Standards and Test Procedures. Contractor shall provide step-up/step-down transformers and AC to DC power conversion as needed to match the power requirements of each component.

2.1.7.7.1 Multifunction T1 Router: A multi-function network device such as the Industrial Frame Router (single T1 CSU/DSU, Ethernet switch, and Terminal Server) shall receive Ethernet and EIA-232 channels from a Qwest provided T1. The router's internal devices shall provide a port for interfacing the local controller and provide another port for interfacing the multi-point communications transceiver (OTR, TWP modem or spread spectrum equipment). Additional devices such as a CCTV camera assembly¸ Dynamic Message Signs and Video detection when installed shall receive an Ethernet or EIA-232 port.

2.1.7.7.2 Field Hardened Network Gateway Router (FHNGR) with four port T1 Multiplexer, and Field Hardened Ethernet Backbone Switch (FHEBS)/Field Hardened Ethernet Access Switch (FHEAS): A multi-function network device such as the FHNGR (four T1 CSU/DSUs, Ethernet switch, and Terminal Server) shall receive Ethernet and EIA-232 channels from the Qwest provided multi-port T1s. The FHNGR for each location shall interface with up to four T1s and will act as the gateway to the MCDOT TMC. Each FHEBS/FHEAS shall provide a pathway to a terminal server for interfacing with the local controller and other analog devices using EIA-232. Additional devices such as a CCTV camera assembly¸ Dynamic Message Signs and Video detection when installed shall receive an Ethernet or EIA-232 port. This configuration of terminal servers shall be installed in each cabinet.

2.1.7.7.3 Layer 3 Router, T1 Multiplexer, and Ethernet Switch: A network device such as a Layer 3 router shall route Ethernet traffic across Local Area Networks (LANs), Virtual Local Area Networks (VLANs), and Wide Area Networks (WANs) to the MCDOT TMC. The Layer 3 router for each side shall interface with the eight-port T1 Multiplexer/Demultiplexer at each Traffic Management Center or Network Operations Center. Each Ethernet switch shall provide a pathway to the Field Hardened Ethernet Access Switches (FHEAS) which will provide a communication link to each cabinet. Devices such as the local controller, CCTV camera assembly, Dynamic Message Signs, and Video detection when installed shall receive an Ethernet or EIA-232 port. This configuration of terminal servers shall be installed in each cabinet.

Two interconnect cables, four-foot minimum, shall be provided with the line-sharing unit; one for interconnecting to the local controller directly and the other for interconnecting directly to the communication transceiver (OTR, TWP modem or spread spectrum equipment).

2.1.7.8 Industrial Frame Router

2.1.7.8.1 Functional Requirements: Industrial frame routers to be located in the traffic signal controller cabinet shall comply with the following minimum requirements:

2.1.7.8.1.1 Minimum four RS232 DTE serial interfaces with DB9 female connectors;

2.1.7.8.1.2 Five 10/100 Base TX Ethernet ports;

2.1.7.8.1.3 T-1 CSU/DSU interface;

2.1.7.8.1.4 Functions to include terminal server, Ethernet switch, IP router, Frame Relay Access Device (FRAD), CSU/DSU, and broadcast of M-cast traffic (IGMP);

2.1.7.8.1.5 Operating temperature range from -40 degrees Fahrenheit to 160 degrees Fahrenheit;

2.1.7.8.1.6 High voltage power range of 90 to 250 VAC;

2.1.7.8.1.7 Frequency range of 50 to 60 Hz; and

2.1.7.8.1.8 Power consumption: 85 W.

Industrial frame routers shall be supplied with all necessary cabling to provide a functional system.

The industrial frame router shall be Dymec DynaStar 1500 IFR, or approved equivalent.

2.1.7.9 Field Hardened Network Gateway Router (FHNGR)

2.1.7.9.1 Functional Requirements: The fiber equipment shall meet the following requirements:

2.1.7.9.1.1 High-performance Network Router supporting standard OSI Layer 3 functionality.

2.1.7.9.1.2 Router shall support direct connectivity to existing networks configured in ring and mesh fault tolerant topologies enabling applications to operate reliably, and with low latency.

2.1.7.9.1.3 All FHNGR, FHEAS, and FHEBS are to be from the same manufacturer.

2.1.7.9.1.4 Equipment shall have licenses for all software or hardware in the system.

2.1.7.9.1.5 Configurable in point-to-point, daisy-chain, ring, and mesh topologies for connectivity into new and existing fiber optic and copper-based Ethernet networks.

2.1.7.9.1.6 Designed with an operating system that allows individual ports to be configured for port mirroring, speed, duplex, auto-negotiation, and flow control. The operating system shall also provide for broadcast storm frame filtering with user defined thresholds.

2.1.7.9.1.7 Designed with an operating system that allows for the collection of statistics on a per port basis and provides for full support of RMON statistics, history, alarms, and event groups.

2.1.7.9.1.8 Designed with an operating system that provides port security to prevent unknown devices from gaining access to the network. Unauthorized attempts to access the network shall result in the port being shut down for a period of time along with Simple Network Management Protocol (SNMP) trap and alarm generation.

2.1.7.9.1.9 High-strength 18-gauge galvanized steel enclosure to seal out insects, dirt, smoke, and other contaminants.

2.1.7.9.1.10 All modules and assemblies are to be clearly identified with name, model number, serial number, or any other pertinent information required to facilitate equipment maintenance.

2.1.7.9.1.11 The equipment shall comply with the following Institute of Electrical and Electronics Engineers (IEEE) Standard Specifications:

2.1.7.9.1.11.1 IEEE 802.3-10BaseT

2.1.7.9.1.11.2 IEEE 802.3d-MAC Bridges

2.1.7.9.1.11.3 IEEE 802.3u-100BaseTX, 100BaseFX

2.1.7.9.1.11.4 IEEE 802.3x-Flow Control

2.1.7.9.1.11.5 IEEE 802.3z-1000BaseLX

2.1.7.9.1.11.6 RFC1294-Frame Relay

2.1.7.9.1.11.7 RFC1305-NTP

2.1.7.9.1.11.8 RFC1321-PPP (MD5)

2.1.7.9.1.11.9 RFC1332-PPP (IPCP)

2.1.7.9.1.11.10 RFC1334-PPP Authentication

2.1.7.9.1.11.11 RFC1490-Frame Relay

2.1.7.9.1.11.12 RFC1519-CIDR

2.1.7.9.1.11.13 RFC1541-DHCP (client)

2.1.7.9.1.11.14 RFC1661-PPP

2.1.7.9.1.11.15 RFC2068-HTTP

2.1.7.9.1.11.16 RFC2338-VRRP

2.1.7.9.1.11.17 RFC2819-RMON MIB

2.1.7.9.1.11.18 RFC768-UDP

2.1.7.9.1.11.19 RFC783-TFTP

2.1.7.9.1.11.20 RFC791-IP

2.1.7.9.1.11.21 RFC792-ICMP

2.1.7.9.1.11.22 RFC793-TCP

2.1.7.9.1.11.23 RFC826-ARP

2.1.7.9.1.11.24 RFC854-Telnet

2.1.7.9.2 FHNGR Physical Requirements

2.1.7.9.2.1 Operates as a Layer 3 to serve as network gateways between the MCDOT.

2.1.7.9.2.2 TMC, Field Hardened Ethernet Backbone Switch, and the Field Hardened.

2.1.7.9.2.3 Ethernet Switches in the field.

2.1.7.9.2.4 Two built-in 100 MB full-duplex or higher switched Ethernet single-mode fiber ports with the ability to reach the necessary distance.

2.1.7.9.2.5 Two switched 10/100 MB Ethernet or higher copper (RJ 45) ports.

2.1.7.9.2.6 Four T1/E1 unchannelized WAN ports.

A FHNGR shall be used in conjunction with a terminal server to interface with Video Detection, Wireless Radio system, and the Signal Controller.

2.1.7.9.3 Serial Expansion Device

2.1.7.9.3.1 Serial expansion device shall comply with the following minimum requirements:

2.1.7.9.3.1.1 One 10/100 Ethernet LAN port with RJ45 connector;

2.1.7.9.3.1.2 Four RS-232 serial ports;

2.1.7.9.3.1.3 Surge protection on all ports;

2.1.7.9.3.1.4 230 Kbps throughput on all ports;

2.1.7.9.3.1.5 LEDs for serial and Ethernet activity;

2.1.7.9.3.1.6 Port buffering up to 64 Kilobytes per Second (Kbps) per port;

2.1.7.9.3.1.7 Power requirement: 100 to 250 VAC;

2.1.7.9.3.1.8 Frequency range of 47 to 63 Hz;

2.1.7.9.3.1.9 Power consumption 12 W; and

2.1.7.9.3.1.10 Operating temperature range of -29 degrees Fahrenheit to 165 degrees Fahrenheit.

The serial expansion device shall be supplied with all necessary cabling to provide full operation. The terminal server shall be compatible with the ASC2/2100 Signal Controller.

2.1.7.10 Field Hardened Ethernet Access Switch (FHEAS)

2.1.7.10.1 All FHEAS shall be of the same manufacturer. All equipment shall be new and in strict accordance with the details shown on the plans and the specifications.

2.1.7.10.2 A high-performance managed Field Hardened Ethernet Switch shall support standard Open System Interconnection (OSI) Layer 2. FHEAS shall support direct connectivity to existing networks configured in ring and mesh fault tolerant topologies enabling applications to operate reliably, and with low latency.

2.1.7.10.3 All equipment shall include licenses, where required, for any software or hardware in the system.

2.1.7.10.4 FHEAS shall comply with the following Institute of Electrical and Electronics Engineers (IEEE) Standard Specifications:

2.1.7.10.4.1 IEEE 802.1d: Spanning Tree Protocol

2.1.7.10.4.2 IEEE 802.1p: Class of Services

2.1.7.10.4.3 IEEE 802.1q: VLAN Tagging

2.1.7.10.4.4 IEEE 802.1w: Rapid Spanning Tree Protocol

2.1.7.10.4.5 IEEE 802.3: 10BASE-T

2.1.7.10.4.6 IEEE 802.3ab: 1000BASE-TX

2.1.7.10.4.7 IEEE 802.3d: MAC Bridges

2.1.7.10.4.8 IEEE 802.3u: 100BASE-TX, 100BASE-FX

2.1.7.10.4.9 IEEE 802.3x: Flow Control

2.1.7.10.4.10 IEEE 802.3z: 1000BASE-LX

2.1.7.10.4.11 RFC768: UDP

2.1.7.10.4.12 RFC783: TFTP

2.1.7.10.4.13 RFC791: IP

2.1.7.10.4.14 RFC792: ICMP

2.1.7.10.4.15 RFC793: TCP

2.1.7.10.4.16 RFC826: ARP

2.1.7.10.4.17 RFC854: Telnet

2.1.7.10.4.18 RFC894: IP over Ethernet

2.1.7.10.4.19 RFC1112: IGMP v1

2.1.7.10.4.20 RFC1493: Bridge MIB

2.1.7.10.4.21 RFC1519: CIDR

2.1.7.10.4.22 RFC1541: DHCP (client)

2.1.7.10.4.23 RFC1907: SNMP v2 MIB

2.1.7.10.4.24 RFC2012: TCP MIB

2.1.7.10.4.25 RFC2013: UDP MIB

2.1.7.10.4.26 RFC2030: SNTP

2.1.7.10.4.27 RFC2068: HTTP

2.1.7.10.4.28 RFC2236: IGMP v2

2.1.7.10.4.29 RFC2578: SNMP v2 SMI

2.1.7.10.4.30 RFC2579: SNMP v2 TC

2.1.7.10.4.31 RFC2819: RMON MIB

2.1.7.10.4.32 RFC2863: IF MIB

2.1.7.10.5 All FHEAS shall have a physical design that conforms to the following requirements:

2.1.7.10.5.1 Two Gigabit Ethernet full-duplex switched Ethernet single-mode fiber ports.

2.1.7.10.5.2 Eight switched 10/100 MB Ethernet or higher copper (RJ 45) ports.

2.1.7.10.5.3 Be configurable in point-to-point, daisy-chain, ring, and mesh topologies for connectivity into new and existing fiber optic and copper-based Ethernet networks.

2.1.7.10.5.4 Designed with an operating system that allows individual ports to be configured for port mirroring, speed, duplex, auto-negotiation, and flow control. The operating system shall also provide for broadcast storm frame filtering with user defined thresholds.

2.1.7.10.5.5 Designed with an operating system allows for the collection of statistics on a per port basis and provides for full support of Remote Monitoring (RMON) statistics, history, alarms, and event groups.

2.1.7.10.5.6 Designed with an operating system that provides port security to prevent unknown devices from gaining access to the network. Unauthorized attempts to access the network shall result in the port being shut down for a period of time along with Simple Network Management Protocol (SNMP) trap and alarm generation.

2.1.7.10.5.7 Have high-strength 18-gauge galvanized steel enclosure to seal out insects, dirt, smoke, and other contaminants.

2.1.7.10.5.8 Clearly identify all modules and assemblies with name, model number, serial number, or any other pertinent information required to facilitate equipment maintenance.

2.1.7.10.6 The equipment shall have the following functionality and features:

2.1.7.10.6.1 Ports Performance

2.1.7.10.6.1.1 Provide Ethernet Single-mode Fiber ports that operate at 1000 Mbps with a link loss budget sufficient for the fiber link it will use.

2.1.7.10.6.1.2 Provide Ethernet RJ-45 ports that auto-negotiate operation at 10/100Mbps or higher if available.

2.1.7.10.6.1.3 Provide external optical attenuators as necessary to support interconnectivity with close range devices upstream or downstream.

2.1.7.10.6.2 Packet-Processing

2.1.7.10.6.2.1 Processing type: store and forward

2.1.7.10.6.2.2 Auto-learning: 8192 Media Access Control (MAC) address

2.1.7.10.6.2.3 Frame buffer memory: 2 Mbit

2.1.7.10.6.2.4 Switching Latency: 7 microseconds

2.1.7.10.6.2.5 Priority queues: 4

2.1.7.10.6.2.6 Virtual Local Area Networks (VLANs): 8192

2.1.7.10.6.2.7 Internet Group Management Protocol (IGMP) multicast groups: 256

2.1.7.10.6.2.8 Switching bandwidth: 5.6 Gbps

2.1.7.10.6.3 Ethernet Network Connectors

2.1.7.10.6.3.1 Eight RJ-45 connector ports for 10/100 Mbps or higher

2.1.7.10.6.3.2 Two dual LC connector 1000 Mbps ports for single-mode fiber

2.1.7.10.6.4 LED Indicators: One LED for power; three LEDs per Ethernet port for link, Tx, and Rx activity.

2.1.7.10.6.5 Power Supply

2.1.7.10.6.5.1 AC power connector: Terminal block at rear of power supply chassis

2.1.7.10.6.5.2 Input Voltage: 85 to 264 VAC (auto-ranging)

2.1.7.10.6.5.3 Power Consumption: 8 watts (max)

2.1.7.10.6.5.4 Fast Transient Protection: Compliant with IEEE C37.90.1

2.1.7.10.6.6 Mechanical

2.1.7.10.6.6.1 Enclosure: Rugged 18-gauge high-strength galvanized steel case with metal mounting plate included. Suitable for stand-alone, shelf, pedestal or wall mounting. Enclosure shall be permanently and clearly identified with name, model number, serial number, and any other pertinent information required to facilitate equipment maintenance.

2.1.7.10.6.6.2 Meet all of its specified requirements when the input power is 115 VAC ±10 percent, 60 ± 3 Hz, for any Field Hardened Ethernet Access Switch furnished or installed under this item.

2.1.7.10.6.6.3 Design the equipment such that the failures of the equipment shall not cause the failure of any other unit of equipment connected upstream or downstream of the device.

2.1.7.10.6.6.4 Make all parts out of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass.

2.1.7.10.6.6.5 Protect all materials used in construction from fungus growth and moisture deterioration.

2.1.7.10.6.6.6 Meet all specified requirements during uncontrolled environmental operations characterized by an operating temperature range of -34 degrees Celsius (-29 degrees Fahrenheit) to +74 degrees Celsius (165 degrees Fahrenheit) and a humidity range of 10 percent to 95 percent (non-condensing).

2.1.7.10.6.7 FHEAS shall be EtherWAN 78900EX or equivalent

2.1.7.11 Field Hardened Ethernet Backbone Switch (FHEBS)

2.1.7.11.1 All FHEBS and FHEAS shall be from the same manufacturer. All equipment shall be new.

2.1.7.11.2 A high-performance and Field Hardened Ethernet Backbone Switch shall support standard OSI Layer 2 functionality. The FHEBS shall support direct connectivity to existing networks configured in ring and mesh fault tolerant topologies enabling applications to operate reliably, and with low latency.

2.1.7.11.3 FHEBS shall include all equipment licenses, where required, for any software or hardware in the system.

2.1.7.11.4 FHEBS shall comply with the following Institute of Electrical and Electronics Engineers (IEEE) Standard Specifications:

2.1.7.11.4.1 IEEE 802.1d: Spanning Tree Protocol

2.1.7.11.4.2 IEEE 802.1p: Class of Services

2.1.7.11.4.3 IEEE 802.1q: VLAN Tagging

2.1.7.11.4.4 IEEE 802.1w: Rapid Spanning Tree Protocol

2.1.7.11.4.5 IEEE 802.3: 10BASE-T

2.1.7.11.4.6 IEEE 802.3ab: 1000BASE-TX

2.1.7.11.4.7 IEEE 802.3d: MAC Bridges

2.1.7.11.4.8 IEEE 802.3u: 100BASE-TX, 100BASE-FX

2.1.7.11.4.9 IEEE 802.3x: Flow Control

2.1.7.11.4.10 IEEE 802.3z: 1000BASE-LX

2.1.7.11.4.11 RFC768: UDP

2.1.7.11.4.12 RFC783: TFTP

2.1.7.11.4.13 RFC791: IP

2.1.7.11.4.14 RFC792: ICMP

2.1.7.11.4.15 RFC793: TCP

2.1.7.11.4.16 RFC826: ARP

2.1.7.11.4.17 RFC854: Telnet

2.1.7.11.4.18 RFC894: IP over Ethernet

2.1.7.11.4.19 RFC1112: IGMP v1

2.1.7.11.4.20 RFC1493: Bridge MIB

2.1.7.11.4.21 RFC1519: CIDR

2.1.7.11.4.22 RFC1541: DHCP (client)

2.1.7.11.4.23 RFC1661: PPP

2.1.7.11.4.24 RFC1907: SNMP v2 MIB

2.1.7.11.4.25 RFC2012: TCP MIB

2.1.7.11.4.26 RFC2013: UDP MIB

2.1.7.11.4.27 RFC2030: SNTP

2.1.7.11.4.28 RFC2068: HTTP

2.1.7.11.4.29 RFC2236: IGMP v2

2.1.7.11.4.30 RFC2578: SNMP v2 SMI

2.1.7.11.4.31 RFC2579: SNMP v2 TC

2.1.7.11.4.32 RFC2819: RMON MIB

2.1.7.11.4.33 RFC2863: IF MIB

2.1.7.11.5 FHEBS shall have a physical design that conforms to the following requirements:

2.1.7.11.5.1 Operates as a Layer 2 interface to the Network Gateway Router for all Field Hardened Ethernet Switches.

2.1.7.11.5.2 Provide three built-in SFP 1000 MB full-duplex switched Ethernet single-mode fiber ports with the ability to reach the necessary distance.

2.1.7.11.5.3 Provide six switched 10/100/1000 MB Ethernet copper (RJ 45) ports.

2.1.7.11.5.4 Be configurable in point-to-point, daisy-chain, ring, and mesh topologies for connectivity into new and existing fiber optic and copper-based Ethernet networks.

2.1.7.11.5.5 Designed with an operating system that allows individual ports to be configured for port mirroring, speed, duplex, auto-negotiation, and flow control. The operating system shall also provide for broadcast storm frame filtering with user defined thresholds.

2.1.7.11.5.6 Designed with an operating system allows for the collection of statistics on a per port basis and provides for full support of RMON statistics, history, alarms, and event groups.

2.1.7.11.5.7 Have high-strength 18-gauge galvanized steel enclosure to seal out insects, dirt, smoke, and other contaminants.

2.1.7.11.5.8 Clearly identify all modules and assemblies with name, model number, serial number, or any other pertinent information required to facilitate equipment maintenance.

2.1.7.11.6 FHEBS shall have the following functionality and features:

2.1.7.11.6.1 Ports Performance

2.1.7.11.6.1.1 Provide Ethernet Single-mode Fiber ports that operate at 1000 Mbps with a link loss budget sufficient for the link it will use.

2.1.7.11.6.1.2 Provide Ethernet RJ-45 ports that auto-negotiate operation at 10/100/1000 Mbps.

2.1.7.11.6.1.3 Provide external optical attenuators as necessary to support interconnectivity with close range devices upstream or downstream.

2.1.7.11.6.2 Packet-Processing

2.1.7.11.6.2.1 Frame buffer memory: 2 Mbit

2.1.7.11.6.2.2 IGMP multicast groups: 256

2.1.7.11.6.2.3 MAC address table size: 64kbytes

2.1.7.11.6.2.4 MAC addresses: 8192

2.1.7.11.6.2.5 Priority Queues: 4

2.1.7.11.6.2.6 Switching bandwidth: 9.2 Gbps

2.1.7.11.6.2.7 Switching latency: 7 us

2.1.7.11.6.2.8 Switching method: Store & Forward

2.1.7.11.6.2.9 VLANs: 4094

2.1.7.11.6.3 Ethernet Network Connectors

2.1.7.11.6.3.1 Six RJ-45 connector ports for 10/100/1000 Mbps

2.1.7.11.6.3.2 Three dual LC connector 1000 Mbps ports for single-mode fiber

2.1.7.11.6.4 LED Indicators: One LED for power; three LEDs per Ethernet port for link, Tx, and Rx activity

2.1.7.11.6.5 Power Supply

2.1.7.11.6.5.1 AC power connector: Terminal block at rear of power supply chassis

2.1.7.11.6.5.2 Input Voltage: 85 to 264 VAC (auto-ranging)

2.1.7.11.6.5.3 Power Consumption: 20 watts (max)

2.1.7.11.6.5.4 Fast Transient Protection: Compliant with IEEE C37.90.1

2.1.7.11.6.6 Mechanical

2.1.7.11.6.6.1 Enclosure: Rugged 18-gauge high-strength galvanized steel case with metal mounting plate included. Suitable for stand-alone, rack, shelf, pedestal or wall mounting. Enclosure shall be permanently and clearly identified with name, model number, serial number, and any other pertinent information required to facilitate equipment maintenance.

2.1.7.11.7 FHEBS shall comply with all specified requirements when the input power is 115 VAC ± 10 percent, 60 ± 3 Hz, for any FHEBS furnished or installed under this item.

2.1.7.11.8 The equipment shall be designed such that the failures of the equipment shall not cause the failure of any other unit of equipment connected upstream or downstream of the device.

2.1.7.11.9 All parts shall be made out of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass.

2.1.7.11.10 All materials used in construction shall be protected from fungus growth and moisture deterioration.

2.1.7.11.11 All specified requirements shall be met during uncontrolled environmental operations characterized by an operating temperature range of -34 degrees Celsius (-29 degrees Fahrenheit) to +74 degrees Celsius (165 degrees Fahrenheit) and a humidity range of 95 percent (non-condensing).

2.1.7.11.12 FHEBS shall be EtherWAN IG5-00244RCR or equivalent

2.1.7.12 Ethernet Communications Module For The ASC/2S Controller

2.1.7.12.1 General

2.1.7.12.1.1 The work under this item consists of furnishing all materials and equipment to install a plug-in Ethernet Communications Module for the ASC/2S Signal Controller. The Ethernet Communications Module acts as a Terminal Server allowing transmission of signal data across an Ethernet network. The Ethernet module requires an Internet Protocol (IP) address to communicate to the Traffic Management System (TMS) located at the MCDOT TMC. The Ethernet module allows the TMS to poll the signal controller

one time a second for status of the signal, push/pull traffic timing plans, and collect logs.

2.1.7.12.2 Material Requirements

2.1.7.12.2.1 Ethernet Module

2.1.7.12.2.1.1 Exceeds NEMA TS2 and TS1 requirements.

2.1.7.12.2.1.2 Ethernet Version 2.0

2.1.7.12.2.1.3 IEEE 802.3 compliant

2.1.7.12.2.1.4 10/100 Base-T Auto Sensing

2.1.7.12.2.1.5 Static IP or DHCP Configuration

2.1.7.12.2.1.6 Field Upgradeable firmware via HTTP

2.1.7.12.2.1.7 Configuration and Management through SNMP (read and write)

2.1.7.12.2.1.8 Strong SSL V3.0/TLS V1.0 based encryption (DES, 3DES, AES)

2.1.7.12.2.1.9 32-bit NET+ARM RISC Processor (55 MHz)

2.1.7.12.2.1.10 Status/Diagnostic LED indicators

2.1.7.12.2.1.11 The Ethernet Module shall be an Econolite ASC/2S Ethernet Module.

2.1.7.13 Leased Line Communications Demarcation Point

2.1.7.13.1 General

2.1.7.13.1.1 The work under this item consists of furnishing all materials to install a wooden post and connect one and one-half inch conduit to the post for a leased line communications Demarcation Point. Contractor shall consult MCDOT Standard Details for installation requirements. Conduit shall be paid as a separate item.

2.1.7.13.2 Material Requirements

2.1.7.13.2.1 Four inch by inch by five-foot-long treated wood post

2.1.7.13.2.2 One and one-half inch conduit straps securing conduit to wooden post

2.1.7.14 Construction Requirements

2.1.7.14.1 Field Hardened Ethernet Access Switch (FHEAS) Construction Requirements

2.1.7.14.1.1 Minimum requirements for the contractor or designated subcontractors involved in the installation and testing of the Ethernet equipment are:

2.1.7.14.1.1.1 Five years' experience in the installation and configuration of Ethernet equipment.

2.1.7.14.1.1.2 Two years direct experience in the configuration and deployment of the Rapid Spanning Tree protocol.

2.1.7.14.1.1.3 Two installed systems where Ethernet switches are installed, and the system has been in continuously satisfactory operation for at least two years. Contractor shall submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the communication system.

2.1.7.14.1.1.4 Necessary documentation of contractor qualifications must be approved by the engineer prior to purchasing the FHEAS.

2.1.7.14.1.2 Installation of the equipment shall provide for ease of maintenance; all component parts shall be readily accessible for inspection and maintenance. All external screws, nuts and locking washers shall be stainless steel. Self-tapping screws shall not be used unless specifically approved by the engineer.

2.1.7.14.1.3 Comply with all requirements of the National Electrical Code for all wiring external to the FHEAS switch. Cut all wires to proper length before assembly. Neatly lace wires into cable with nylon lacing or plastic straps. Secure

cables with approved clamps for both fiber and copper cable types. Provide service loops at all connections.

2.1.7.14.1.4 Connecting harnesses (i.e., jumper cables) shall be of appropriate length and terminated with matching connectors for interconnection with the FHEAS switches.

2.1.7.14.1.5 Dissimilar metals shall be separated by an inert dielectric material.

2.1.7.14.2 Field Hardened Ethernet Backbone Switch (FHEBS) Construction Requirements

2.1.7.14.2.1 Minimum requirements for the contractor or designated subcontractors involved in the installation and testing of the Ethernet equipment are:

2.1.7.14.2.2 Five years' experience in the installation and configuration of Ethernet equipment.

2.1.7.14.2.3 Two years direct experience in the configuration and deployment of the Rapid Spanning Tree protocol.

2.1.7.14.2.4 Two installed systems where Ethernet switches are installed, and the system has been in continuously satisfactory operation for at least two years. Contractor shall submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the communication system.

2.1.7.14.2.5 Necessary documentation of subcontractor qualifications must be approved by the engineer prior to purchasing the FHEBS.

2.1.7.14.2.6 Installation of the equipment shall provide for ease of maintenance, with all component parts being readily accessible for inspection and maintenance.

2.1.7.14.2.7 Ensure that all external screws, nuts and locking washers are stainless steel. Do not use any self-tapping screws unless specifically approved by the engineer.

2.1.7.14.2.8 Meet all requirements of the National Electrical Code for all wiring external to the ES switch. Cut all wires to proper length before assembly. Neatly lace wires into cable with nylon lacing or plastic straps. Secure cables with approved clamps for both fiber and copper cable types. Provide service loops at all connections.

2.1.7.14.2.9 Provide connecting harnesses (i.e., jumper cables) of appropriate length and terminated with matching connectors for interconnection with the ES switches.

2.1.7.14.2.10 Separate dissimilar metals by an inert dielectric material.

2.1.7.15 Testing Requirements

2.1.7.15.1 Contractor shall demonstrate that the equipment and the systems furnished and installed under the contract function in full compliance with the requirements of the contract documents. Contractor shall furnish and maintain all required test equipment. Conduct tests in the presence of the engineer using approved test procedures and submit the test results to the engineer using approved test data forms. Engineer will review the test results for conformance with the requirements of the contract documents. If the equipment or systems fail any part of the test, the contractor shall make necessary corrections and repeat the entire test.

2.1.7.15.2 Notify the engineer of the time, date and place of all tests at least 14 calendar days prior to the date on which a test is planned.

2.1.7.15.3 Engineer may waive the right to witness certain tests.

2.1.7.15.4 Contractor shall ensure that all equipment to be tested is ready for testing prior to the performance of, and engineer's witnessing of the tests. Costs for transportation, meals, and lodging for the engineer and his representatives that are associated with delays in the testing will be deducted from monies due, or to become due, or owed to the contractor.

2.1.7.15.5 All test data forms shall be signed by the contractor or authorized representative.

2.1.7.15.6 When tests are witnessed by the engineer, the contractor shall obtain the witnessing engineer's signature on the test data form.

2.1.7.15.7 The contract period will not be extended for time loss or delays related to testing.

2.1.7.15.8 Failure of any item to meet the requirements for any test will be counted as a defect and the equipment under test will be subject to rejection by the engineer. Rejected equipment may be re-tested provided all areas of non-compliance have been corrected and evidence thereof is submitted to the engineer by the contractor.

2.1.7.15.9 For equipment that has failed and subsequently been repaired or modified, the contractor shall prepare and deliver a report to the engineer that describes the nature of the failure and the corrective action taken. Re-design and modification of failed equipment shall be done at no additional cost.

2.1.7.15.10 Contractor shall conduct or support tests in the following stages of implementation:

2.1.7.15.10.1 Design Approval Test (DAT);

2.1.7.15.10.2 Factory Demonstration Test (FDT) (when required);

2.1.7.15.10.3 Factory Acceptance Test (FAT);

2.1.7.15.10.4 Stand-Alone Test;

2.1.7.15.10.5 Subsystem Test (SST);

2.1.7.15.10.6 Systems Integration Test (SIT) (when required); and

2.1.7.15.10.7 System Acceptance Test (SAT).

2.1.7.15.11 DAT verify that certain design parameters are satisfied prior to going to production.

2.1.7.15.12 FDT are performed on a production unit and verify that the equipment meets the functional requirements. FAT verify that each unit of equipment as it comes off the production line operates as specified. Stand-alone tests verify that after installation but prior to interconnection, the equipment operates as specified. SSTs verify that units forming a subsystem continue to operate as specified when they are interconnected.

2.1.7.15.13 The SIT is performed when previously untested hardware or software is developed and/or added to an existing system to verify that all system interfaces perform properly prior to final acceptance. The duration of the SIT shall be based on the complexity of the design. The SAT verifies that all the interconnected subsystems operate together as one system. Upon successful completion and acceptance of the SAT, the project will advance to the warranty and operational support period.

2.1.7.15.14 Design Approval Tests (DAT)

2.1.7.15.14.1 A DAT shall be conducted when required by the Specifications. Contractor shall provide certification from the manufacturer for the following:

2.1.7.15.14.1.1 The equipment has been laboratory tested and meets or exceeds the environmental requirements of the Specifications. Specifically list test results and passing criteria for each required test.

2.1.7.15.14.1.2 The equipment meets the functional requirements stated in the Specifications and is suitable for the intended application. The certification shall state any requirements that are not met or have not been laboratory tested. Test procedures and results, or independent laboratory certification shall be made available upon request.

2.1.7.15.14.2 DAT certification shall meet the requirements stated in Section 2.1.3.1.1 for Certificates of Compliance. If a DAT and a Certificate of Compliance is required for the same equipment, both requirements may be satisfied by a single Certificate of Compliance.

2.1.7.15.14.3 Submit DAT certification with the equipment submittal data for engineer's approval.

2.1.7.15.14.4 The engineer may waive the DAT requirement for equipment that has been previously tested by the MCDOT or certified for use in prior projects where the application is consistent and results deemed favorable.

2.1.7.15.14.5 Contractor should contact MCDOT for information regarding the DAT or certification status of a particular device.

2.1.7.15.14.6 Provide DAT certification for the camera, lens, pan/tilt unit, environmental enclosure, and camera control receiver for equipment the contractor desires to have as an approved equal.

2.1.7.15.15 Factory Demonstration Tests (FDT)

2.1.7.15.15.1 A FDT shall be conducted when required by the Specifications. A FDT shall be conducted on a prototype model before going to production. The FDT requirement for models of equipment previously tested and/or certified by the MCDOT for the types of applications required in the project may be waived by the engineer.

2.1.7.15.15.2 To gain a waiver, the contractor shall submit certification from the manufacturer that states that the equipment has been tested and meets all the project requirements.

2.1.7.15.15.3 State any exceptions or requirements not covered by testing. Provide supporting

information such as test procedures, data, and results.

2.1.7.15.15.4 Costs for lodging and transportation for the engineer and his representatives to witness the FDT, will be borne by MCDOT, for one visit lasting for up to five consecutive days. In the event, the FDT requires multiple visits by the engineer or lasts longer than five consecutive days, the contractor shall be responsible for the added cost of transportation and lodging beyond what is covered by the County.

2.1.7.15.16 Factory Acceptance Tests (FAT)

2.1.7.15.16.1 A FAT shall be conducted on each unit of equipment. The FAT shall verify proper operation of all required functions. Contractor shall submit FAT results for approval and shall not deliver equipment until FAT results have been approved by MCDOT.

2.1.7.15.17 Stand-Alone Tests

2.1.7.15.17.1 The stand-alone test verifies after installation, but prior to connection to the system, that the equipment is capable of performing the function for which it was designed. Contractor shall conduct approved stand-alone tests on each equipment group that performs a specific function. Testing is to use the manufacturer's approved software after the on-site installation of the equipment group is completed. Contractor shall furnish all necessary test equipment and test software.

2.1.7.15.17.2 For each unit of equipment, conduct approved stand-alone tests that exercise all stand-alone (non-network) functional operations of the equipment including the following:

2.1.7.15.17.2.1 Control of focus, iris, and power on/off;

2.1.7.15.17.2.2 Range of pan, tilt, zoom and digital zoom;

2.1.7.15.17.2.3 Presence and quality of video signal;

2.1.7.15.17.2.4 Camera ID and preset text generation; and

2.1.7.15.17.2.5 Pan and tilt limit stops are set to the engineer's specification.

2.1.7.15.18 Subsystem Tests (SST)

2.1.7.15.18.1 SST verify that units forming a subsystem continue to operate as specified when they are interconnected. A subsystem is defined as a logical grouping of field devices and/or central equipment that when interconnected and communicating, is capable of performing the function for which it was designed (i.e. – CCTV cameras, communications to/from the cameras, central control and display of the video images). Contractor shall conduct approved SST for the field equipment and related equipment at the hubs and the Traffic Management Center (TMC). Conduct SST on the groups of equipment as identified in the project Special Provisions after the equipment has been installed and interconnected.

2.1.7.15.18.2 Subsystem tests shall not be considered successful until all equipment being tested is operational without failure for 72 consecutive hours.

2.1.7.15.19 System Integration Test (SIT)

2.1.7.15.19.1 The SIT is performed when previously untested hardware or software is developed and/or added to an existing system to verify that all system interfaces perform properly prior to final acceptance. Contractor shall begin the SIT upon completion of all the SSTs. Contractor is responsible to keep the installed equipment operational during the system final integration as determined by the engineer. Contractor shall identify the SIT in the project schedule. Contractor shall work with the engineer to troubleshoot all problems related to non-specification compliant equipment and interfaces.

2.1.7.15.20 System Acceptance Test (SAT)

2.1.7.15.20.1 The SAT verifies that all the interconnected subsystems operate together as one system. The SAT may commence upon completion of the SIT. The SAT consists of a 30-day test period demonstrating that the total system (hardware, software, materials and construction) is properly installed, is free from identified problems, exhibits stable and reliable performance, and complies with the contract documents.

2.1.7.15.20.2 Contractor shall demonstrate all system functions using live control equipment. Test all normal and backup functions of redundant system equipment and include in the SAT

any emergency conditions for which the equipment is designed to respond.

2.1.7.15.20.3 Contractor shall troubleshoot, diagnose, identify, and isolate hardware and software problems and inconsistencies. Formulate possible solutions and implement all corrections needed for the contractor installed equipment.

2.1.7.15.20.4 Contractor shall make available on-site, key technical personnel familiar with the design and construction of each major system component within 48 hours of notification of a problem.

2.1.7.15.20.5 Contractor shall correct all system documentation errors, omissions, and changes discovered and resulting from the SAT and previous testing. System acceptance will not be complete until corrected documentation is submitted.

2.1.7.15.20.6 In the event of a failure of a single piece of equipment during the SAT, the contractor shall replace or repair the equipment and restart the 30-day test only for that piece of equipment. If the failure of the single piece of equipment prevents the proper operation of other equipment (e.g. – failure of the video encoder prevents proper camera control), all devices affected by the failure will have the test extended by however many days they were out of service.

2.1.7.15.20.7 The following conditions constitute a minor system failure and will result in a suspension of time during the 30-day SAT. After satisfactory remedial action, the 30-day test will be resumed and extended one additional day:

2.1.7.15.20.7.1 Interference with project operations due to vandalism, traffic accident, power failure, or lightning for which lightning protection devices as specified are not sufficient protection;

2.1.7.15.20.7.2 Failure to complete the objective of any test scenario due to lack of adequate documentation for equipment supplied by the contractor. Contractor shall re-test using revised documentation; and

2.1.7.15.20.7.3 Intermittent hardware, software, communication, or operation control malfunctions.

2.1.7.15.20.8 The following constitutes a major system failure. Any one of the following conditions shall result in re-initialization of the SAT from day zero:

2.1.7.15.20.8.1 Failure of five percent of any hardware or performance item within a 14-day period; and

2.1.7.15.20.8.2 Failure to correct any problem that adversely impacts the safety of the traveling public, the engineer, or his representatives within four hours of notification.

2.1.7.15.21 Test Procedures, Software, and Data Forms

2.1.7.15.21.1 Contractor shall prepare test procedures, software (when needed) and data forms for all required DAT, FDT, FAT, stand-alone, SST, and SAT procedures.

2.1.7.15.21.2 Submit test procedures, software, and data forms to the engineer for approval at least 45 calendar days before the scheduled testing. Engineer will review the submitted procedures, software, and data forms and return them within 14 calendar days after receipt. If approved, tests may be conducted as scheduled. If rejected, reschedule the test, revise the submittal accordingly and resubmit for another review. Highlight the portions of the submittal that have changed to aid the engineer's re-review of the material. Extension of the schedule will not be granted for rejected test procedures, software, and data forms.

2.1.7.15.21.3 As a minimum, prepare test procedures and data forms that include the following:

2.1.7.15.21.3.1 A step-by-step outline of the test sequence to be followed, showing a test of every function of the equipment or system to be tested;

2.1.7.15.21.3.2 A description of the expected operation,

pass/fail criteria, and test results;

2.1.7.15.21.3.3 A data form to be used to record all data and quantitative results obtained during the test; and

2.1.7.15.21.3.4 A description of any special equipment, setup, manpower, or conditions required for the test.

2.1.7.16 Warranty Requirements

2.1.7.16.1 If specific warranty requirements apply, they are listed under specific equipment requirements of the specifications. The cost of warranties and repairs are included as part of the contract unit price.

2.1.7.16.2 Within 60 days following approval of material and equipment, the contractor shall submit a preliminary Warranty Administration Plan (WAP) to the engineer for approval.

2.1.7.16.3 The WAP is to address how the warranty period shall be administered, including the following requirements:

2.1.7.16.3.1 A 24/7/365 day a week telephone number for MCDOT initiated warranty requests;

2.1.7.16.3.2 Repair or replace failed items that prevent normal operation of the system or any of the subsystems within five calendar days after notification. Respond to all other warranty requests within fourteen calendar days;

2.1.7.16.3.3 Track each repair performed during the warranty period by serial number. Account for removals, replacements, and repaired items put back in service or into the spare inventory. Reset the warranty period for all repaired or replaced items. Establish a new warranty period for all new items;

2.1.7.16.3.4 Perform routine maintenance during the warranty period per vendor recommendations.

2.1.7.16.3.5 Provide a summary of all routine maintenance activities required, whether or not they fall within the one-year warranty period;

2.1.7.16.3.6 When used, replenish spare equipment inventory within two weeks, or stated vendor lead-time, whichever is greater;

2.1.7.16.3.7 Provide a complete list of equipment and vendor warranty periods, including spare equipment. Use Figure 480.1 or similar approved form; and

2.1.7.16.3.8 Provide copies of all warranty paperwork.

2.1.7.16.4 Submit a final WAP to the engineer for approval at least 45 days prior to final acceptance. An approved WAP is required prior to final acceptance.

2.1.7.16.5 Prior to final acceptance, furnish an inventory of spare parts.

2.1.7.16.6 Within 90 days and no later than 30 days prior to the end of the one-year warranty period, submit the following to the engineer for approval:

2.1.7.16.6.1 A complete list of all equipment (by serial number) that have warranties extending beyond the one-year warranty period, including spare equipment. Use Figure 2.1.2.4 or similar approved form; and

2.1.7.16.6.2 All warranty paperwork extending beyond the one-year period, transferring ownership of the warranties to MCDOT.

Figure 2.1.2.4 Equipment Warranties

Project Name Equipment Warranties Submitted By: Date:			Project No.: Federal Project No.:			
Serial #	Description	Location	Warranty Duration	Expiration Date	Date Received	Other Information

2.1.7.17 Documentation

2.1.7.17.1 Deliver a minimum of two sets of maintenance manuals to the engineer for all furnished equipment. The manuals shall be supplied in durable, loose-leaf, three ring binders of appropriate size. All sections shall be permanently titled and have pages numbered and indexed for easy and efficient removal and replacement. In addition, an electronic copy of all manuals shall be provided for all equipment and software.

2.1.7.17.2 Format maintenance manuals in two sections that include the following material for all furnished equipment and components:

2.1.7.17.3 Section 1

2.1.7.17.3.1 Description for each type of equipment and its components.

2.1.7.17.3.2 Description of operation.

2.1.7.17.3.3 Troubleshooting procedures at system and device levels.

2.1.7.17.3.4 Preventative maintenance and adjustment procedures.

2.1.7.17.3.5 “As-built” drawings including block diagrams, signal path, and detailed device and system connection diagrams (reference Section 2.1.6.2.3).

2.1.7.17.3.6 Equipment source reference including manufacturer and nearest authorized service centers along with associated addresses and telephone numbers.

2.1.7.17.3.7 Final warranty administration plan.

2.1.7.17.4 Section 2

2.1.7.17.4.1 Manufacture’s operation and installation.

2.1.7.17.4.2 Manufacture’s service and repair guides.

2.1.7.17.4.3 Contractor shall provide maintenance manuals for CCTV equipment per the above requirements, including the following diagrams (as appropriate):

2.1.7.17.4.3.1 Video system block diagram showing all components;

2.1.7.17.4.3.2 Video signal path diagram;

2.1.7.17.4.3.3 Control signal path diagram;

2.1.7.17.4.3.4 System connection diagram; and

2.1.7.17.4.3.5 Detailed connection diagrams.

2.1.7.18 Training

2.1.7.18.1 When required, training shall be provided in two sessions.

2.1.7.18.2 The first training session shall be for maintenance and troubleshooting. This session shall be a minimum of four hours in length for each type of field device installed, including communications. This session shall be oriented for the County maintenance staff.

2.1.7.18.3 The second training session shall be for operations. This session shall be a minimum of four hours in length for each

type of field device installed. This session shall be oriented for the County Traffic Management staff.

2.1.7.19 Measurement

2.1.7.19.1 The Field Hardened Ethernet Access Switch shall be measured per unit furnished, installed, made fully functional, tested, and accepted by the engineer.

2.1.7.19.2 The Field Hardened Ethernet Backbone Switch shall be measured per each unit furnished, installed, made fully functional, tested, and accepted by the engineer.

2.1.7.19.3 Routers shall be measured by each type furnished, installed, and accepted complete in place.

2.1.7.19.4 Switches shall be measured by each type furnished, installed, and accepted complete in place.

2.1.7.19.5 Ethernet Communications Module for the ASC/2S Signal Controller shall be measured as a unit for each accepted installation complete in place.

2.1.7.19.6 Leased Line Communications Demarcation Point will be measured as a unit for each accepted installation complete in place.

2.1.7.20 Payment

2.1.7.20.1 The accepted quantities of Field Hardened Ethernet Access Switch measured as provided above, will be paid for at the contract unit price, which price shall be full compensation for the item, COMPLETE IN PLACE, including all equipment described under this Item with all cables and connectors; all documentation and testing and also includes the cost of furnishing all labor, materials, software, warranty, training and equipment necessary to complete the work.

2.1.7.20.2 Field Hardened Ethernet Backbone Switch, measured as provided above, will be paid for at the contract unit price, which price shall be full compensation for the item, COMPLETE IN PLACE, including all equipment described under this Item with all cables and connectors; all documentation and testing and also includes the cost of furnishing all labor, materials, software, warranty, training and equipment necessary to complete the work.

2.1.7.20.3 The accepted quantity of items will be paid for at the contract unit price which shall be full compensation for the work described including testing, warranty, documentation, and training.

2.1.8 Intelligent Transportation System (ITS) General Requirements

This section consists of additional requirements for the work of furnishing and installing complete, functional and operating ITS field devices, such as fiber optic cable cellular routers, FHEAS, FHEBS, CV, ITS infrastructure, closed circuit television cameras (CCTV), dynamic message signs (DMS), and video image

detectors (VID). Unless specified within other sections of these Specifications, the following requirements apply to all materials/equipment supplied by this contract.

2.1.8.1 Material/Equipment Requirements and Technical Qualifications

2.1.8.1.1 Environmental

2.1.8.1.1.1 All electronic equipment installed in the field shall meet the minimum environmental requirements of NEMA Standards Publication No. TS-2, Section 2, Environmental Standards and Test Procedures, including, but not limited to:

2.1.8.1.1.1.1 Power Interruption;

2.1.8.1.1.1.2 Temperature and Humidity;

2.1.8.1.1.1.3 Transients, Power Service and Input Terminals;

2.1.8.1.1.1.4 Nondestructive Transient Immunity;

2.1.8.1.1.1.5 Vibration; and

2.1.8.1.1.1.6 Shock.

2.1.8.1.1.2 All equipment exposed to the environment shall be corrosion resistant and designed to withstand 80 mph winds with a 30 percent gust factor, and withstand the effects of sand, dust, and hose-directed water per the hose down test described in the latest edition of the NEMA Standards Publication 250. All connections shall be watertight.

2.1.8.1.2 Power

2.1.8.1.2.1 Electronic equipment and power supply shall meet the minimum requirements of NEMA Standards Publications No. TS-2, Section 2 Environmental Standards and Test Procedures.

2.1.8.1.2.2 Contractor shall provide step-up/step-down transformers and AC to DC power conversion as needed to match the power requirements of each component.

2.1.8.1.3 Regulation and Codes

2.1.8.1.3.1 All electrical equipment shall conform to the current standards of the National Electrical Manufacturers Association (NEMA), National Electric Safety Code (NESC), and Underwriters' Laboratory Inc. (UL). All material and workmanship shall conform to the requirements of the National Electric

Code (NEC), Illumination Engineers Society (IES), Standards of the ASTM, American Association of State Highway and Transportation Officials (AASHTO), requirements of the project plans, these specifications, the special provisions, and to any other codes, standards, or ordinances which may apply. Whenever references are made to any of the standards mentioned, the reference shall be interpreted to mean the code, ordinance, or standard that is in effect at the time of the bid advertisement. All ITS network equipment purchased shall have a local vendor supported United States serial number and MAC address that identifies the manufacturer and OS version installed.

2.1.8.1.4 Approval of Material, Equipment, and Technical Qualifications

2.1.8.1.4.1 All materials, equipment, and ITS technical qualifications shall be approved by the engineer prior to proceeding with the ITS work.

2.1.8.1.5 Materials and Equipment

2.1.8.1.5.1 Any work in which materials or equipment not previously approved are used shall be performed at the contractor's risk and may be considered as unauthorized and unacceptable and not subject to the payment provisions of the contract. Such materials or equipment may be subject to removal at the discretion of the engineer.

2.1.8.1.5.2 Before ordering or installing any material or equipment, the contractor shall submit four copies of each proposed material and/or equipment list, including shop drawings and warranty information to the County at the pre-construction conference for approval by the engineer. To be acceptable, the list shall be complete and contain all items supplied on the project by the contractor, including pre-approved items. MCDOT reserves the right to reject an incomplete or unclear material submittal. All items on the list shall be identified by manufacturer's part number, model, included or excluded options, specification or other pertinent catalogue information. The materials from any catalog cuts shall be clearly indicated by the contractor. One copy will be returned to the contractor for further action. Substitution of brand name, part number, or model number may be made if it is in accordance with the specifications and is equal in form, fit, function, performance, reliability, and is

approved by the engineer. All proposed substitutions shall be identified in the material and/or equipment list submitted for approval. Contractor shall provide complete wiring diagrams for controller assemblies and auxiliary controller cabinets at the time of delivery for testing. A mylar original and four sets of prints shall be provided with each controller assembly. The wiring diagram shall illustrate all circuits and components in detail. All components shall be identified by name or number so as to be clearly noted in the drawings.

2.1.8.1.6 Technical Qualifications

2.1.8.1.6.1 Contractor shall submit the technical qualifications of personnel to be used for construction of ITS facilities to the engineer at the pre-construction conference. Contractor or subcontractor personnel must be certified by the manufacturer or have an industry standard certification prior to the installation and/or integration of the designated ITS equipment. The installation and configuration personnel shall have a predetermined number of years of experience in addition to the certification levels as outlined below:

2.1.8.1.6.2 Fiber Technician – Minimum is Electronics Technicians Association (ETA) Fiber Optical Installer (FOI) certification or manufacturer fiber certification with five years of hands-on experience.

2.1.8.1.6.3 A year of experience can be waived if a higher level of certification in the appropriate field is possessed.

2.1.8.1.6.4 A copy of a resume with five project references and three professional references may be submitted for consideration of approval for individuals not meeting the required certification and experience levels.

2.1.8.1.6.5 The technical qualifications listed above will be waived for equipment that is designated as “furnish only”.

2.1.8.1.7 Maricopa County Furnished Material and Equipment

2.1.8.1.7.1 Field Devices material and equipment furnished by MCDOT will be made available to the contractor as specified in the Special Provisions. All specified items will be available at the following address:

Maricopa County Department of Transportation Warehouse
2222 South 27th Avenue
Phoenix, Arizona 85009-6357

2.1.8.1.7.2 Contractor shall call (602) 506-4885 48 hours prior to pick-up. Hours of Operation are Monday - Thursday 5:00 a.m. - 3:30 p.m. MST.

2.1.8.1.7.3 The cost of handling and placing all material and equipment, after transfer to the contractor, shall be considered as included in the contract price for the item in connection with which they are used.

2.1.8.1.7.4 Contractor shall be held responsible for all material and equipment dispersed to the contractor. The cost to make good any shortages or deficiencies, from any cause whatsoever and for any damage which may occur after transfer will be deducted from any monies due or becoming due to the contractor.

2.1.8.1.8 Product Training

2.1.8.1.8.1 A training course for each category of equipment shall be provided as an additional option to be requested from the contractor as needed. Training shall be considered “hands-on” training and be comprehensive enough to provide administrative, technical, and operational instruction in the use of the provided equipment. Training courses offered shall require a factory certified installer for the installation, configuration, and maintenance of the equipment.

2.1.8.1.8.2 The training course shall be defined into one four-hour training course and one eight-hour training course blocks. The County may request individual equipment components or combination of equipment components to be included in the training blocks requested based on the level of detail needing to be trained on each component. Contractor and the County shall decide on the training schedule once equipment needing training has been defined. The training shall be provided after the successful completion of all Subsystem Tests.

2.1.8.1.8.3 Costs should include materials and travel costs for vendor to provide training at the County facility. Contractor shall provide materials for up to five students for the training course. Additional materials shall be

provided for additional students as a per student cost.

2.1.8.2 Method of Construction

2.1.8.2.1 Cable and Active Electronics Labeling and Management

2.1.8.2.1.1 Contractor shall provide labeling for all contractor installed cables. Labeling shall be done in a neat, professional manner using permanent methods and products specifically designed and approved by the engineer for each label scenario. At a minimum, provide the following labeling:

2.1.8.2.1.1.1 Trunkline and branch cables at pull boxes, cabinets, racks, and other points of entry with the appropriate cable identification number. Use permanently marked, removable cable sleeves;

2.1.8.2.1.1.2 Both ends of jumper cables and pigtails;

2.1.8.2.1.1.3 Sequentially label the jumper cable (front) side of patch panels in a consistent manner throughout the project; and

2.1.8.2.1.1.4 Labeling for all active electronics consisting of the device location, name, IP address, subnet mask, gateway and VLAN.

2.1.8.2.1.1.5 Provide cable routing and management in a neat and professional manner. Group and neatly tie cables to the sides of racks when applicable. Slack or excess cables shall be neatly coiled, tied, and stowed. Strain relief shall be provided for fiber optic cable, jumpers, and pigtails.

2.1.8.2.2 Labor and Supervision

2.1.8.2.2.1 Contractor shall furnish technically qualified labor and supervision with experience in the construction of the ITS field devices and communications equipment encompassed by the project, to include all materials, equipment, tools, transportation and supplies

required to complete the work in an acceptable manner; and in full compliance with the Specifications, the project plans, and Special Provisions.

2.1.8.2.2.2 Contractor shall always have on the work site a competent supervisor capable of reading and thoroughly understanding the plans and specifications and be experienced in the construction of ITS field devices and communications encompassed by the project. When construction involves traffic signals, the contractor's supervisor shall possess an International Municipal Signal Association (IMSA) Level II Traffic Signal Electrician Certification.

2.1.8.2.3 Plans

2.1.8.2.3.1 The plans may graphically describe the location of component parts. Where dimensions on the plans are given or can be computed from other given dimensions, they shall govern over scaled dimension.

2.1.8.2.3.2 After completion of the project the contractor shall provide the engineer with a set of as-built drawings on clean prints of the original drawings. The as-built drawing shall indicate in a neat and accurate manner all changes and revisions in the original design. As-built drawings shall be submitted before final payment for completed work will be made.

2.1.8.3 Connected Vehicle (CV) Equipment

2.1.8.3.1 The work under this section shall consist of furnishing, installing, and testing CV equipment including surge protection, software, and various accessories as needed. CV equipment includes, but is not limited to, the following components: Onboard Units (OBUs), Roadside Units (RSUs) and roadside processors.

2.1.8.4 Material Requirements

2.1.8.4.1 Environmental

2.1.8.4.1.1 All electronic equipment installed in the field shall meet the minimum environmental requirements of NEMA Standards Publication No. TS-2, Section 2, Environmental Standards and Test Procedures, including, but not limited to:

2.1.8.4.1.1.1 Power Interruption;

2.1.8.4.1.1.2 Temperature and Humidity;

2.1.8.4.1.1.3 Transients, Power Service and Input Terminals;

2.1.8.4.1.1.4 Nondestructive Transient Immunity;

2.1.8.4.1.1.5 Vibration; and

2.1.8.4.1.1.6 Shock.

2.1.8.4.1.2 All equipment exposed to the environment shall be corrosion resistant and designed to withstand 80 mph winds with a 30 percent gust factor, and withstand the effects of sand, dust, and hose-directed water per the hose down test described in the latest edition of the NEMA Standards Publication 250. All connections shall be watertight.

2.1.8.4.1.3 CV equipment shall meet the above environmental requirements, except that the camera assembly shall perform to the stated specifications over an ambient temperature range of -30 degrees Fahrenheit to +158 degrees Fahrenheit.

2.1.8.4.2 Roadside Units (RSU)

2.1.8.4.2.1 Shall broadcast SAE J2735 Signal Phase and Timing, MAP and Signal Status Messages (SSM) received from the roadside processor and forward J2735 Basic Safety Messages (BSM) and Signal Request Messages (SRM) received from OBUs to the roadside processor. RSUs will have the ability to connect to the MCDOT Security Credential Management System (SCMS) to maintain IEEE 1609.2 certificates for signing SAE J2735 messages and shall be enrolled prior to installation

2.1.8.4.2.2 RSUs shall be dual-mode, capable of operating over either Dedicated Short Range Communications (DSRC) bands or over C-V2X (Cellular-Vehicle-to-Everything) bands and shall come equipped with antennas, Power-over-Ethernet (PoE) adaptors/injectors, mounting brackets and hardware, Ethernet cables and any other ancillary components required for installation and operation.

2.1.8.4.2.3 RSUs should meet CTI 4001 v01.00 roadside unit standard and should be OmniAir certified.

2.1.8.4.3 Onboard Units

2.1.8.4.3.1 Shall broadcast SAE J2735 Basic Safety Messages and Signal Request Messages to the Roadside Units. OBUs must be capable of

receiving certification top off from the MCDOT SCMS to ensure compliance with IEEE 1609.2.

2.1.8.4.4 Roadside Processors

2.1.8.4.5 Shall communicate with the Roadside Units and signal controller to enable message exchange and processing of commands with the intersection hardware. Roadside processors must be capable of hosting the Multi-Modal Intelligent Traffic Signal System (MMITSS) software and communicating with the traffic signal controller using National Transportation Communications for ITS Protocol (Protocol) NTCIP 1202 messaging.

2.1.8.5 Construction Requirements

Contractor shall coordinate with MCDOT engineer or assigned representative for specific device placement. Contractor shall install the CV equipment according to manufacturing recommendations with the approval of MCDOT engineer or assigned representative. Contractor shall include all cables and additional components as necessary for CV equipment installation. All cables between the RSU and the signal cabinet shall not be longer than required and shall be continuous, with no splices. The cables shall be routed and fastened for permanent installation.

2.1.8.6 Testing Requirements

Contractor shall demonstrate that the equipment and the systems furnished and installed under the contract function in full compliance with the requirements of the contract documents.

2.1.8.7 Warranty Requirements

Contractor shall provide a minimum two-year hardware warranty for all CV equipment components.

2.1.8.8 Documentation

Deliver a minimum of two sets of maintenance manuals to the engineer for all furnished equipment.

2.1.8.9 Measurement

CV Equipment components, either RSU, OBU or roadside processors, including cables, power supplies, software, and various accessories as needed will be measured as a unit for each installed.

Testing, warranty, documentation, and training are considered incidental to the item requiring the work.

2.1.8.10 Payment

The accepted quantities of items, measured as above, will be paid for at the contract unit price, COMPLETE IN PLACE, which price shall be full compensation for the work described. COMPLETE IN PLACE, including all equipment described under this item with all cables and connectors; all documentation and testing, including the cost of furnishing all labor,

materials, software, warranty, training, and equipment necessary to complete the work.

2.1.9 Connected Temporary Traffic Control Devices TTCDs

The work under this section shall consist of furnishing, installing, and testing Connected TTCDs, which may include vehicle-mounted or standalone arrow boards as well as barricades and traffic cones. Devices shall include GPS and remote communications capabilities and shall comply with Part 6 of the current edition of the MUTCD.

2.1.9.1 Material Requirements

2.1.9.1.1 Connected_TTCDs

2.1.9.1.1.1 Environmental: All electronic equipment installed in the field shall meet the minimum environmental requirements of NEMA Standards Publication No. TS-2, Section 2, Environmental Standards and Test Procedures, including, but not limited to:

2.1.9.1.1.1.1 Power Interruption;

2.1.9.1.1.1.2 Temperature and Humidity;

2.1.9.1.1.1.3 Transients, Power Service and Input Terminals;

2.1.9.1.1.1.4 Nondestructive Transient Immunity;

2.1.9.1.1.1.5 Vibration; and

2.1.9.1.1.1.6 Shock.

2.1.9.1.1.2 All equipment exposed to the environment shall be corrosion resistant and designed to withstand 80 mph winds with a 30 percent gust factor, and withstand the effects of sand, dust, and hose-directed water per the hose down test described in the latest edition of the NEMA Standards Publication 250. All connections shall be watertight.

2.1.9.1.1.3 Connected TTCDs shall meet the above environmental requirements, except that the camera assembly shall perform to the stated specifications over an ambient temperature range of -30 degrees Fahrenheit to +158 degrees Fahrenheit.

2.1.9.1.1.4 shall include a solar power system, a locked battery box, a display, control functions, a minimum of four operation modes, GPS and remote communications surge protection, software, ability to interface with existing traffic control equipment, and various accessories as needed.

2.1.9.2 Power System

2.1.9.2.1 When the Connected TTCDs are vehicle mounted, they shall connect directly to the vehicle power without adverse impact to the operation of the vehicle or other onboard equipment.

2.1.9.2.2 When the Connected TTCDs are solar powered, they shall charge and maintain batteries automatically without intervention and be designed for year-round deployment. No component shall create a shadow on any portion of the solar panels and the battery box shall be capable of being securely locked.

2.1.9.2.3 When the Connected TTCDs are standalone, they shall be powered by a rechargeable battery that provides a minimum of 100 hours of continuous operation and shall have an external charging port or pin contacts to allow recharging without device disassembly.

2.1.9.2.4 Devices shall have the capability to be “grouped” with other Connected TTCDs so that they may be turned on/off automatically when others are activated. However, all Connected TTCDs shall be capable of being turned on/off independently.

2.1.9.3 Display

2.1.9.3.1 Connected TTCDs with an arrow display shall have a minimum display area of 96 inches wide by 48 inches tall, a minimum legibility distance of 1 mile, and a minimum number of elements (pixels) of 15. Elements shall be capable of a least 50 percent dimming from full brightness with dimmed mode used for nighttime operation.

2.1.9.3.2 The following four modes are the minimum required:

2.1.9.3.2.1 Off (except for charging system) the entire unit is Off. If solar panels are present, they will charge the batteries in this position.

2.1.9.3.2.2 Sequential Chevron

2.1.9.3.2.3 Flashing Double Arrow

2.1.9.3.2.4 Alternating Diamond

2.1.9.4 GPS and Communications

2.1.9.4.1 Connected TTCDs shall have the ability to receive and transmit their GPS coordinates (latitude and longitude) with an accuracy of 3 meters Circular Error Probable (CEP).

2.1.9.4.2 Connected TTCDs must provide real-time device status and location information at 15-second intervals via a free API for ingestion into existing MCDOT systems.

2.1.9.5 Construction Requirements

2.1.9.5.1 Contractor shall coordinate with MCDOT engineer or assigned representative for specific locations.

2.1.9.5.2 Contractor shall install the device according to manufacturing guidelines with the approval of MCDOT engineer or assigned representative.

2.1.9.6 Testing Requirements

2.1.9.6.1 Contractor shall demonstrate that the equipment and the systems furnished and installed under the contract function in full compliance with the requirements of the contract documents.

2.1.9.7 Warranty Requirements

2.1.9.7.1 Contractor shall provide a minimum two-year hardware warranty.

2.1.9.8 Documentation

2.1.9.8.1 Deliver a minimum of two sets of maintenance manuals to the engineer for all furnished equipment.

2.1.9.8.2 Contractor shall provide maintenance manuals for equipment, including the following diagrams (as appropriate):

2.1.9.8.2.1 System block diagram showing all components.

2.1.9.8.2.2 System connection diagram; and

2.1.9.8.2.3 Detailed connection diagrams.

2.1.9.9 Training

2.1.9.9.1 When required, training shall be provided in two sessions.

2.1.9.9.2 The first training session shall be for maintenance and troubleshooting. This session shall be a minimum of four hours in length. This session shall be oriented for the County maintenance staff.

2.1.9.9.3 The second training session shall be for operations. This session shall be a minimum of four hours in length. This session shall be oriented for the County Traffic Management staff.

2.1.9.10 Measurement

2.1.9.10.1 The Connected TTCDs, along with any various accessories as needed, will be measured as a unit for each installed.

2.1.9.10.2 Testing, warranty, documentation, and training are considered incidental to the item requiring the work.

2.1.9.11 Payment

2.1.9.11.1 The accepted quantities of items, measured as above, will be paid for at the contract unit price, COMPLETE IN PLACE, which price shall be full compensation for the work described. COMPLETE IN PLACE, including all equipment described under this item with all cables and connectors; all documentation and testing, including the cost of furnishing all labor, materials, software, communication, warranty, training and equipment necessary to complete the work or any other incidental non-equipment pricing

2.2 TECHNICAL AND DESCRIPTIVE SALES LITERATURE

The contractor shall provide copies of its sales literature and brochures and copies of any manufacturer's technical and/or descriptive literature (e.g., PDF versions of sales literature, brochures, and/or webpages) specific to the material(s) the contractor proposes to provide. Literature shall be sufficient in detail to allow for full and fair evaluation of the material(s) submitted and must be included with the bid. Failure to include this information may result in the bid being rejected.

3.0 PURCHASING REQUIREMENTS

3.1 DELIVERY

3.1.1 Delivery is desired as soon as possible, and details shall be stipulated on the purchase order. Contractor shall notify the County representative listed on the purchase order if the requested delivery date and/or the anticipated lead time cannot be met. Failure to communicate to County changes in the order status may result in default proceedings.

3.1.2 Supplies or equipment shall be delivered between the hours of 5:30 a.m. and 3:30 p.m. Mountain Standard Time (MST), Monday through Friday, except on County recognized holidays.

3.1.3 Delivery shall be F.O.B. Destination Freight Prepaid.

3.2 EXPEDITED DELIVERY

3.2.1 If the department determines that expedited delivery or other alternate shipping is required, it shall notify the contractor. The contractor shall determine any additional costs associated with such delivery terms and communicate that cost to the department.

3.2.2 The department shall not advise the contractor to proceed with an expedited shipment until acceptable terms are agreed upon and a purchase order is issued. Upon agreeing to the additional costs, the department shall advise the contractor to proceed.

3.2.3 Upon receipt of material(s) and invoicing, the department shall ensure that any additional charges are in compliance with and do not exceed agreed to costs. The department shall retain all documents related to these costs within the agency purchase file.

3.3 SHIPPING DOCUMENTS

A packing list or other suitable shipping document shall accompany each shipment and shall include the following:

3.3.1 Contract serial number

3.3.2 Contractor's name and address

3.3.3 Department name and address

3.3.4 Department purchase order number

3.3.5 A description of product(s) shipped, including item number(s), quantity(ies), number of containers and package number(s), as applicable

3.4 SHIPPING TERMS

Bid price(s) and terms shall be F.O.B. Destination Freight Prepaid at the location(s) stipulated on the purchase order. All delivery locations are within Maricopa County.

3.5 OPERATING MANUALS

Upon delivery, contractor shall provide comprehensive operational manuals, service manuals and schematic diagrams, if required by the department.

3.6 INSTALLATION

The contractor shall be responsible to install and present for inspection all equipment in a complete and ready-for-use condition with all components functioning, cleaned and tested. The contractor's price shall include delivery and installation of all equipment in complete operating condition.

3.7 SAMPLES

The contractor may be requested to furnish samples of material(s) bid to allow for examination by the County. Any materials so requested shall be furnished within 10 working days from the date of request and furnished at no cost to the County and sent to the address designated in the requesting correspondence.

3.8 TESTING

Unless otherwise specified, materials purchased will be inspected by the department to ensure the materials meet the quality and quantity requirements of the specifications. When deemed necessary by the County, samples of the materials may be taken at random from stock received for submission to a commercial laboratory or other appropriate agency for analysis and tests to determine whether the materials conform in all respects to the specifications. In cases where commercial laboratory reports determine that the materials do not meet the specifications, the expense of such analysis shall be borne by the contractor.

3.9 ACCEPTANCE

Upon delivery and successful installation, the material(s) shall be deemed accepted and the warranty period shall begin. Successful installation shall be defined as a) the material(s)/equipment is installed (as necessary) and fully operational; and b) initial training, if any, is complete. All documentation shall be completed prior to final acceptance.

3.10 TRAINING

Contractor shall provide training services, upon request, to County personnel in the use and care of all equipment/materials and services (as applicable) and respond with hourly rate for such on Attachment D – Pricing Sheet. All training shall take place on-site in Maricopa County.

3.11 STOCK

The contractor shall be expected to stock sufficient quantities as may be necessary to meet the County's needs and deliver as stated in the Invitation for Bids.

3.12 DISCONTINUED MATERIALS

3.12.1 In the event that a manufacturer discontinues materials, the County may allow the contractor to provide a substitute for the discontinued item or may cancel the contract. If the contractor requests permission to substitute a new material, the contractor shall provide the following to the County:

3.12.1.1 Documentation from the manufacturer that the material has been discontinued.

3.12.1.2 Documentation that names the replacement material.

3.12.1.3 Documentation that provides clear and convincing evidence that the replacement material meets or exceeds all specifications required by the original solicitation.

3.12.1.4 Documentation that provides clear and convincing evidence that the replacement material will be compatible with all the functions or uses of the discontinued material.

3.12.1.5 Documentation confirming that the price for the replacement is the same as or less than the discontinued material.

3.12.2 Material discontinuance applies only to those materials specifically listed on any resultant contract. This will not apply to catalog items not specifically listed on any resultant contract.

3.13 WARRANTY

3.13.1 All items furnished under this contract shall conform to the requirements of this contract and shall be free from defects in design, materials, and workmanship.

3.13.2 The warranty period for workmanship and materials shall be for a minimum initial period of 12 months and commence upon acceptance by County per Section 3.9 - Acceptance.

3.13.2.1 The contractor shall indicate on the price sheet the duration of the warranty and any applicable limitations or conditions which may apply.

3.13.2.2 The contractor agrees that it will, at its own expense, provide all labor and parts required to remove, repair, or replace, and reinstall any such defective workmanship and/or materials which becomes or is found to be defective during the term of this warranty. The contractor shall guarantee the equipment to be supplied complies with all applicable regulations.

3.14 MAINTENANCE

The contractor shall provide maintenance for the materials under this contract upon acceptance of materials by the department.

3.15 FACTORY AUTHORIZED SERVICE AVAILABILITY

The contractor shall have and maintain a factory authorized service facility capable of supplying and installing component parts, troubleshooting, repairing, and maintaining the material(s). Minimum service hours shall be from 8:00 a.m. through 5:00 p.m. MST, Monday through Friday, excluding County and Federal holidays.

3.16 BRAND NAME

In some cases, brand names have been listed in order to define the desired quality and are not intended to be restrictive or to limit competition. Materials substantially equivalent to those designated shall qualify for consideration.

3.17 MODEL/YEAR OF MATERIALS

The County will only accept bids offering the most current model/year equipment/material(s).

3.18 ORDER CUTOFF INFORMATION

3.18.1 Contractors submitting bids shall advise the County of all known order cutoff dates/times for the equipment/product(s) specified in this solicitation at the time of bid submission. Notification of any subsequent cutoff date(s)/time(s) (learned after submission of bid) shall also be the contractor's responsibility. The contractor shall advise the County of subsequent cutoff date(s)/time(s) by notifying the procurement officer, in writing, of the new information.

3.18.2 If the item(s) become no longer available, contractor shall notify County of the last available ordering date for the item(s) and may provide County with alternative item(s) that the County may elect to purchase at its option. If the alternative item(s) do not meet the County's requirements, County may take action including termination of this contract for convenience per Section 4.15 – Termination for Convenience.

3.19 ORDER LEAD-TIME NOTIFICATION

3.19.1 Contractors submitting bids shall advise the County of lead-time(s) for the required items specified in this solicitation at the time of bid submission. Notification of any changes to lead time (learned after submission of bid) shall also be the contractor's responsibility. The contractor shall also notify all County representatives included on purchase orders of lead-time information.

3.20 USAGE REPORT

The contractor shall furnish the County a usage report, upon request, delineating the acquisition activity governed by the contract. The format of the report shall be approved by the County and shall disclose the quantity and dollar value of each contract item by individual unit of measure.

3.21 BACKGROUND CHECK

Bidders/proposers may be required to pass multiple background checks (e.g., Sheriff's Office, County Attorney's Office, Courts, as well as Maricopa County general government) to determine if the respondent is acceptable to do business with the County. This applies to, but is not limited to, the company, subcontractors, and employees.

3.22 INVOICES AND PAYMENTS

3.22.1 The contractor shall submit one legible copy of their detailed invoice before payment(s) will be made. Incomplete invoices will not be processed. At a minimum, the invoice must provide the following information:

- Company name, address, and contact information
- County bill-to name and contact information
- Contract serial number
- County purchase order number
- Invoice number and date
- Payment terms
- Date of service or delivery
- Quantity
- Contract item number(s)
- Arrival and completion time
- Description of purchase (product or services)
- Pricing per unit of purchase
- Extended price
- Freight (if applicable)
- Total amount due

3.22.2 Labor, services, and maintenance must be billed as a separate line item.

3.22.3 Problems regarding billing or invoicing shall be directed to the department as listed on the purchase order.

3.22.4 Payment will only be made to the contractor by Accounts Payable through the Maricopa County Vendor Express Payment Program. This is an Electronic Funds Transfer (EFT) process. After contract award, the contractor shall complete the Vendor Registration Form located on the County Department of Finance Vendor Registration website https://www.maricopa.gov/5169/Vendor-Information.

3.22.5 Discounts offered in the contract shall be calculated based on the date a properly completed invoice is received by the County.

3.22.6 EFT payments to the routing and account numbers designated by the contractor shall include the details on the specific invoices that the payment covers. The contractor is required to discuss remittance delivery capabilities with their designated financial institution for access to those details.

3.23 APPLICABLE TAXES

3.23.1 It is the responsibility of the contractor to determine any and all applicable taxes and include those taxes in their proposal. The legal liability to remit the tax is on the entity conducting business in Arizona. Tax is not a determining factor in contract award.

3.23.2 The County will look at the price or offer submitted and will not deduct, add, or alter pricing based on speculation or application of any taxes, nor will the County provide contractor any advice or guidance regarding taxes. If you have questions regarding your tax liability, seek advice from a tax professional prior to submitting your bid. You may also find information at https://www.azdor.gov/Business.aspx. Once your bid is submitted, the offer is valid for the time specified in this solicitation, regardless of mistake or omission of tax liability. If the County finds overpayment of a project due to tax consideration that was not due, the contractor shall be liable to the County for that amount, and by contracting with the County agrees to remit any overpayments back to the County for miscalculations on taxes included in a bid price.

3.23.3 Tax Indemnification: Contractor and all subcontractors shall pay all Federal, state, and local taxes applicable to their operation and any persons employed by the contractor. Contractor shall, and require all subcontractors to, hold Maricopa County harmless from any responsibility for taxes, damages, and interest, if applicable, contributions required under Federal and/or state and local laws and regulations, and any other costs including: transaction privilege taxes, unemployment compensation insurance, Social Security, and Workers' Compensation. Contractor may be required to establish, to the satisfaction of County, that any and all fees and taxes due to the City or the State of Arizona for any license or transaction privilege taxes, use taxes, or similar excise taxes are currently paid (except for matters under legal protest).

3.24 POST AWARD MEETING

The contractor may be required to attend a post-award meeting with the department to discuss the terms and conditions of this contract. This meeting will be coordinated by the procurement officer of the contract.

3.25 STRATEGIC ALLIANCE for VOLUME EXPENDITURES (SAVE)

The County is a member of the SAVE cooperative purchasing group. SAVE includes the State of Arizona, many Phoenix metropolitan area municipalities, and many K-12 unified school districts. Under the SAVE Cooperative Purchasing Agreement, and with the concurrence of the successful respondent under this solicitation, a member of SAVE may access a contract resulting from a solicitation issued by the County. If contractor does not want to grant such access to a member of SAVE, state so in the bid. In the absence of a statement to the contrary, the County will assume that contractor does wish to grant access to any contract that may result from this bid. The County assumes no responsibility for any purchases by using entities.

3.26 INTERGOVERNMENTAL COOPERATIVE PURCHASING AGREEMENTS (ICPAs)

County currently holds ICPAs with numerous governmental entities. These agreements allow those entities, with the approval of the contractor, to purchase their requirements under the terms and conditions of the County contract. It is the responsibility of the non-County government entity to perform its own due diligence on the acceptability of the contract under its applicable procurement rules, processes, and procedures. Certain governmental agencies may not require an ICPA and may utilize this contract if it meets their individual requirements. Other governmental agencies may enter into a separate Statement of Work with the contractor to meet their own requirements. The County is not a party to any uses of this contract by other governmental entities.

4.0 CONTRACTUAL TERMS & CONDITIONS

4.1 CONTRACT TERM

This Invitation for Bids is for awarding a firm, fixed price purchasing contract to cover a term of one year(s).

4.2 OPTION TO RENEW

The County may, at its option and with the concurrence of the contractor, renew the term of this contract up to a maximum of five additional year(s), (or at the County's sole discretion, extend the contract on a month-to-month basis for a maximum of six months after expiration). The contractor shall be notified in writing by the Office of Procurement Services of the County's intention to renew the contract term at least 60 calendar days prior to the expiration of the original contract term.

4.3 CONTRACT COMPLETION

In preparation for contract completion, the contractor shall make all reasonable efforts for an orderly transition of its duties and responsibilities to another provider and/or to the County. This may include, but is not limited to, preparation of a transition plan and cooperation with the County or other providers in the transition. The transition includes the transfer of all records and other data in the possession, custody, or control of the contractor that are required to be provided to the County either by the terms of this agreement or as a matter of law. The provisions of this clause shall survive the expiration or termination of this agreement.

4.4 PRICE ADJUSTMENTS

4.4.1 Any requests for reasonable price adjustments must be submitted 60 calendar days prior to the contract expiration. Requests for adjustment in cost of labor and/or materials must be supported by appropriate documentation. The reasonableness of the request will be determined by comparing the request with the Consumer Price Index or by performing a market survey. If County agrees to the adjusted price terms, County will issue written approval of the change and provide an updated version of the contract. The new change shall not be in effect until the date stipulated on the updated version of the contract.

4.5 INDEMNIFICATION

4.5.1 To the fullest extent permitted by law, and to the extent that claims, damages, losses, or expenses are not covered and paid by insurance purchased by the contractor, the contractor shall defend, indemnify, and hold harmless the County (as Owner), its agents, representatives, officers, directors, officials, and employees from and against all claims, damages, losses, and expenses (including, but not limited to attorneys' fees, court costs, expert witness fees, and the costs and attorneys' fees for appellate proceedings) arising out of, or alleged to have resulted from, the negligent acts, errors, omissions, or mistakes relating to the performance of this contract.

4.5.2 Contractor's duty to defend, indemnify, and hold harmless the County, its agents, representatives, officers, directors, officials, and employees shall arise in connection with any claim, damage, loss, or expense that is attributable to bodily injury, sickness, disease, death, or injury to, impairment of, or destruction of tangible property, including loss of use resulting therefrom, caused by negligent acts, errors, omissions, or mistakes in the performance of this contract, but only to the extent caused by the negligent acts or omissions of the contractor, a subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder.

4.5.3 The amount and type of insurance coverage requirements set forth herein will in no way be construed as limiting the scope of the indemnity in this section.

4.5.4 The scope of this indemnification does not extend to the sole negligence of County.

4.6 INSURANCE

4.6.1 Contractor, at contractor’s own expense, shall purchase and maintain, at a minimum, the herein stipulated insurance from a company or companies duly licensed by the State of Arizona and possessing an AM Best, Inc. category rating of B++. In lieu of State of Arizona licensing, the stipulated insurance may be purchased from a company or companies, which are authorized to do business in the State of Arizona, provided that said insurance companies meet the approval of

County. The form of any insurance policies and forms must be acceptable to County.

4.6.2 All insurance required herein shall be maintained in full force and effect until all work or service required to be performed under the terms of the contract is satisfactorily completed and formally accepted. Failure to do so may, at the sole discretion of County, constitute a material breach of this contract.

4.6.3 In the event that the insurance required is written on a claims-made basis, contractor warrants that any retroactive date under the policy shall precede the effective date of this contract and either continuous coverage will be maintained, or an extended discovery period will be exercised for a period of two years beginning at the time work under this contract is completed.

4.6.4 Contractor's insurance will be primary insurance as respects County, and any insurance or self-insurance maintained by County will not contribute to it.

4.6.5 Any failure to comply with the claim reporting provisions of the insurance policies or any breach of an insurance policy warranty shall not affect the County's right to coverage afforded under the insurance policies.

4.6.6 The insurance policies may provide coverage that contains deductibles or self-insured retentions. Such deductibles and/or self-insured retentions shall not be applicable with respect to the coverage provided to County under such policies. Contractor shall be solely responsible for the deductible and/or self-insured retention and County, at its option, may require contractor to secure payment of such deductibles or self-insured retentions by a surety bond or an irrevocable and unconditional letter of credit.

4.6.7 The insurance policies required by this contract, except Workers' Compensation and Errors and Omissions, shall name County, its agents, representatives, officers, directors, officials, and employees as additional insureds.

4.6.8 The policies required hereunder, except Workers' Compensation and Errors and Omissions, shall contain a waiver of transfer of rights of recovery (subrogation) against County, its agents, representatives, officers, directors, officials, and employees for any claims arising out of contractor's work or service.

4.6.9 If available, the insurance policies required by this contract may be combined with Commercial Umbrella Insurance policies to meet the minimum limit requirements. If a Commercial Umbrella insurance policy is utilized to meet insurance requirements, the Certificate of Insurance shall indicate which lines the Commercial Umbrella Insurance covers.

4.6.9.1 Commercial General Liability

Commercial General Liability (CGL) insurance with a limit of not less than $2,000,000 for each occurrence, $4,000,000 Products/Completed Operations Aggregate, and $4,000,000 General Aggregate Limit. The policy shall include coverage for premises liability, bodily injury, broad form property damage, personal injury, products and completed operations and blanket contractual coverage, and shall not contain any provisions which would serve to limit third-party action over claims. There shall be no endorsement or modifications of the CGL limiting the scope of coverage for liability arising from explosion, collapse, or underground property damage.

4.6.9.2 Automobile Liability

Commercial/Business Automobile Liability insurance with a combined single limit for bodily injury and property damage of not less than $2,000,000 each occurrence with respect to any of the contractor's owned, hired, and non-owned vehicles assigned to or used in performance of the contractor's work or services or use or maintenance of the premises under this contract.

4.6.9.3 Workers' Compensation

4.6.9.3.1 Workers' Compensation insurance to cover obligations imposed by Federal and state statutes having jurisdiction of contractor's employees engaged in the performance of the work or services under this contract; and Employer's Liability insurance of not less than $1,000,000 for each accident, $1,000,000 disease for each employee, and $1,000,000 disease policy limit.

4.6.9.3.2 Contractor, its subcontractors, and sub-subcontractors waive all rights against this contract and its agents, officers, directors, and employees for recovery of damages to the extent these damages are covered by the Workers' Compensation and Employer's Liability or Commercial Umbrella Liability insurance obtained by contractor, its subcontractors, and its sub-subcontractors pursuant to this contract.

4.6.9.4 Errors and Omissions/Professional Liability Insurance

Errors and Omissions (Professional Liability) insurance which will insure and provide coverage for errors or omissions or professional liability of the contractor, with limits of no less than $2,000,000 for each claim.

4.6.10 Certificates of Insurance

4.6.10.1 Prior to contract award**,** contractor shall furnish the County with valid and complete certificates of insurance, or formal endorsements as required by the contract in the form provided by the County, issued by contractor's insurer(s), as evidence that policies providing the required coverage, conditions, and limits required by this contract are in full force and effect. Such certificates shall identify this contract number and title.

4.6.10.2 In the event any insurance policy(ies) required by this contract is (are) written on a claims-made basis, coverage shall extend for two years past completion and acceptance of contractor's work or services and as evidenced by annual Certificates of Insurance.

4.6.10.3 If a policy does expire during the life of the contract, a renewal certificate must be sent to County 15 calendar days prior to the expiration date.

4.6.11 Cancellation and Expiration Notice

Applicable to all insurance policies required within the insurance requirements of this contract, contractor's insurance shall not be permitted to expire, be suspended, be canceled, or be materially changed for any reason without 30 calendar days prior written notice to Maricopa County. Contractor must provide notice to Maricopa County, within two business days of receipt, if they receive notice of a policy that has been or will be suspended, canceled, materially changed

for any reason, has expired, or will be expiring. Such notice shall be sent directly to Maricopa County Office of Procurement Services and shall be mailed or hand delivered to 301 W. Jefferson St. Suite 700, Phoenix, AZ 85003, or emailed to the procurement officer noted in the solicitation.

4.7 FORCE MAJEURE

4.7.1 Neither party shall be liable for failure of performance, nor incur any liability to the other party on account of any loss or damage resulting from any delay or failure to perform all or any part of this contract, if such delay or failure is caused by events, occurrences, or causes beyond the reasonable control and without negligence of the parties. Such events, occurrences, or causes include, but are not limited to, acts of God/nature (including fire, flood, earthquake, storm, hurricane, or other natural disaster), war, invasion, act of foreign enemies, hostilities (whether war is declared or not), civil war, riots, rebellion, revolution, insurrection, military or usurped power or confiscation, terrorist activities, nationalization, government sanction, lockout, blockage, embargo, labor dispute, strike, and interruption or failure of electricity or telecommunication service and pandemic.

4.7.2 Each party, as applicable, shall give the other party notice of its inability to perform and particulars in reasonable detail of the cause of the inability. Each party must use best efforts to remedy the situation and remove, as soon as practicable, the cause of its inability to perform or comply.

4.7.3 The party asserting Force Majeure as a cause for non-performance shall have the burden of proving that reasonable steps were taken to minimize delay or damages caused by foreseeable events, that all non-excused obligations were substantially fulfilled, and that the other party was timely notified of the likelihood or actual occurrence which would justify such an assertion, so that other prudent precautions could be contemplated.

4.8 ORDERING AUTHORITY

Any request for purchase shall be accompanied by a valid purchase order issued by a County department or directed by a Certified Agency Procurement Aid (CAPA) with a purchase card for payment.

4.9 AVAILABILITY OF FUNDS

4.9.1 The provisions of this contract relating to payment shall become effective when funds assigned for the purpose of compensating the contractor as herein provided are actually available to County for disbursement. The County shall be the sole judge and authority in determining the availability of funds under this contract. County will keep the contractor fully informed as to the availability of funds.

4.9.2 If any action is taken by any state agency, Federal department, or any other agency or instrumentality to suspend, decrease, or terminate its fiscal obligations under, or in connection with, this contract, County may amend, suspend, decrease, or terminate its obligations under, or in connection with, this contract. In the event of termination, County will be liable for payment only for services rendered prior to the effective date of the termination, provided that such services are performed in accordance with the provisions of this contract. County will give written notice of the effective date of any suspension, amendment, or termination under this section, at least 10 days in advance.

4.10 PROCUREMENT CARD ORDERING CAPABILITY

County may opt to use a procurement card (Visa or Master Card) to make payment for orders under this contract.

4.11 NO MINIMUM OR MAXIMUM PURCHASE OBLIGATION

This contract does not guarantee any minimum or maximum purchases will be made. Orders will only be placed under this contract when the County identifies a need and proper authorization and documentation have been approved.

4.12 PURCHASE ORDERS

4.12.1 County reserves the right to cancel purchase orders within a reasonable period of time after issuance. Should a purchase order be canceled, the County agrees to reimburse the contractor for actual and documentable costs incurred by the contractor in response to the purchase order. The County will not reimburse the contractor for any costs incurred after receipt of County notice of cancellation, or for lost profits, or for shipment of product prior to issuance of purchase order.

4.12.2 Contractor agrees to accept verbal notification of cancellation of purchase orders from the County with written notification to follow. Contractor specifically acknowledges to be bound by this cancellation policy.

4.13 SUSPENSION OF WORK

The procurement officer may order the contractor, in writing, to suspend, delay, or interrupt all or any part of the work of this contract for the period of time that the procurement officer determines appropriate for the convenience of the County. No adjustment shall be made under this clause for any suspension, delay, or interruption to the extent that performance would have been so suspended, delayed, or interrupted by any other cause, including the fault or negligence of the contractor. No request for adjustment under this clause shall be granted unless the claim, in an amount stated, is asserted in writing as soon as practicable after the termination of the suspension, delay, or interruption, but not later than the date of final payment under the contract.

4.14 STOP WORK ORDER

4.14.1 The procurement officer may, at any time, by written order to the contractor, require the contractor to stop all, or any part, of the work called for by this contract for a period of 90 calendar days after the order is delivered to the contractor, and for any further period to which the parties may agree. The order shall be specifically identified as a stop work order issued under this clause. Upon receipt of the order, the contractor shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of costs allocable to the work covered by the order during the period of work stoppage. Within a period of 90 calendar days after a stop work order is delivered to the contractor, or within any extension of that period to which the parties shall have agreed, the procurement officer shall either:

2.1.6.1 cancel the stop work order; or

2.1.6.2 terminate the work covered by the order as provided in the Termination for Default or the Termination for Convenience clause of this contract.

4.14.2 The procurement officer may make an equitable adjustment in the delivery schedule and/or contract price, and the contract shall be modified, in writing, accordingly, if the contractor demonstrates that the stop work order resulted in an increase in costs to the contractor.

4.15 TERMINATION FOR CONVENIENCE

Maricopa County may terminate the resultant contract for convenience by providing 60 calendar days advance notice to the contractor.

4.16 TERMINATION FOR DEFAULT

4.16.1 The County may, by written Notice of Default to the contractor, terminate this contract in whole or in part if the contractor fails to:

4.16.1.1 deliver the supplies or to perform the services within the time specified in this contract or any extension;

4.16.1.2 make progress, so as to endanger performance of this contract; or

4.16.1.3 perform any of the other provisions of this contract.

4.16.2 The County's right to terminate this contract under these subparagraphs may be exercised if the contractor does not cure such failure within 10 business days (or more if authorized in writing by the County) after receipt of a Notice to Cure from the procurement officer specifying the failure.

4.17 STATUTORY RIGHT OF CANCELLATION FOR CONFLICT OF INTEREST

Notice is given that, pursuant to Arizona Revised Statute (A.R.S.) § 38-511, the County may cancel any contract without penalty or further obligation within three years after execution of the contract, if any person significantly involved in initiating, negotiating, securing, drafting, or creating the contract on behalf of the County is at any time, while the contract or any extension of the contract is in effect, an employee or agent of any other party to the contract in any capacity or consultant to any other party of the contract with respect to the subject matter of the contract. Additionally, pursuant to A.R.S. § 38-511, the County may recoup any fee or commission paid or due to any person significantly involved in initiating, negotiating, securing, drafting, or creating the contract on behalf of the County from any other party to the contract arising as the result of the contract.

4.18 OFFSET FOR DAMAGES

In addition to all other remedies at Law or Equity, the County may offset from any money due to the contractor any amounts contractor owes to the County for damages resulting from breach or deficiencies in performance of the contract.

4.19 CONTRACTOR LICENSE REQUIREMENT

4.19.1 The contractor shall procure all permits, insurance, and licenses and pay the charges and fees necessary and incidental to the lawful conduct of his/her business, and, as necessary, complete any requirements, by any and all governmental or non-governmental entities as mandated to maintain compliance with and remain in good standing. The contractor shall keep fully informed of existing and future trade or industry requirements, and Federal, state, and local laws, ordinances, and regulations which in any manner affect the fulfillment of a contract and shall comply with the same. Contractor shall immediately notify both Office of Procurement Services and the department of any and all changes concerning permits, insurance, or licenses.

4.19.2 Contractor furnishing finished products, materials, or articles of merchandise that will require installation or attachment as part of the contract shall possess any licenses required. Contractor is not relieved of its obligation to obtain and possess the required licenses by subcontracting of the labor portion of the contract. Contractors are advised to contact the Arizona Registrar of Contractors, Chief of Licensing, to ascertain licensing requirements for a particular contract. Contractor shall identify which license(s), if any, the Registrar of Contractors requires for performance of the contract.

4.20 SUBCONTRACTING

4.20.1 The contractor may not assign to another contractor or subcontract to another party for performance of the terms and conditions hereof without the written consent of the County. All correspondence authorizing subcontracting must reference the bid serial number and identify the job or project.

4.20.2 The subcontractor's rate for the job shall not exceed that of the prime contractor's rate, as bid in the Pricing Sheet, unless the prime contractor is willing to absorb any higher rates. The subcontractor's invoice shall be invoiced directly to the prime contractor, who in turn shall pass-through the costs to the County, without mark-up. A copy of the subcontractor's invoice must accompany the prime contractor's invoice.

4.21 AMENDMENTS

All amendments to this contract shall be in writing and approved/signed by both parties. Maricopa County Office of Procurement Services shall be responsible for approving all amendments for Maricopa County.

4.22 ADDITIONS/DELETIONS OF COMMODITIES

The County reserves the right to add and/or delete materials to a contract. If additional materials are required from a contract, prices for such additions will be negotiated between the contractor and the County.

4.23 RIGHTS IN DATA

4.23.1 The County shall have the use of data and reports resulting from a contract without additional cost or other restriction except as may be established by law or applicable regulation. Each party shall supply to the other party, upon request, any available information that is relevant to a contract and to the performance thereunder.

4.23.2 Data, records, reports, and all other information generated for the County by a third party as the result of a contract are the property of the County and shall be provided in a format designated by the County or shall be and remain accessible to the County into perpetuity.

4.24 ACCESS TO AND RETENTION OF RECORDS FOR THE PURPOSE OF AUDIT AND/OR OTHER REVIEW

4.24.1 In accordance with Section MC1-372 of the Maricopa County Procurement Code, the contractor agrees to retain (physical or digital copies of) all books, records, accounts, statements, reports, files, and other records and back-up documentation relevant to this contract for six years after final payment or until after the resolution of any audit questions, which could be more than six years, whichever is longest. The County, Federal or state auditors and any other persons duly authorized by the department shall have full access to and the right to examine, copy, and make use of, any and all said materials.

4.24.2 If the contractor's books, records, accounts, statements, reports, files, and other records and back-up documentation relevant to this contract are not sufficient to support and document that requested services were provided, the contractor shall reimburse Maricopa County for the services not so adequately supported and documented.

4.25 AUDIT DISALLOWANCES

If at any time it is determined by the County that a cost for which payment has been made is a disallowed cost, the County will notify the contractor in writing of the disallowance. The course of action to address the disallowance shall be at sole discretion of the County, and may include either an adjustment to future invoices, request for credit, request for a check, or a deduction from current invoices submitted by the contractor equal to the amount of the disallowance, or to require reimbursement forthwith of the disallowed amount by the contractor by issuing a check payable to Maricopa County.

4.26 STRICT COMPLIANCE

Acceptance by County of a performance that is not in strict compliance with the terms of the contract shall not be deemed to be a waiver of strict compliance with respect to all other terms of the contract.

4.27 VALIDITY

The invalidity, in whole or in part, of any provision of this contract shall not void or affect the validity of any other provision of the contract.

4.28 SEVERABILITY

The removal, in whole or in part, of any provision of this contract shall not void or affect the validity of any other provision of this contract.

4.29 RELATIONSHIPS

4.29.1 In the performance of the services described herein, the contractor shall act solely as an independent contractor, and nothing herein or implied herein shall at any time be construed as to create the relationship of employer and employee, co-employee, partnership, principal and agent, or joint venture between the County and the contractor.

4.29.2 The County reserves the right of final approval on proposed staff. Also, upon request by the County, the contractor will be required to remove any employees working on County projects and substitute personnel based on the discretion of the County within two business days, unless previously approved by the County.

4.30 NON-DISCRIMINATION

Contractor agrees to comply with all provisions and requirements of Arizona Executive Order 2009-09, including flow down of all provisions and requirements to any subcontractors. Executive Order 2009-09 supersedes Executive Order 99-4 and amends Executive Order 75-5 and is hereby incorporated into this contract as if set forth in full herein. During the performance of this contract, contractor shall not discriminate against any employee, client, or any other individual in any way because of that person's age, race, creed, color, religion, sex, disability, or national origin. (Arizona Executive Order 2009-09 can be viewed at https://apps.azsos.gov/public_services/register/2009/46/governor.pdf).

4.31 WRITTEN CERTIFICATION PURSUANT TO A.R.S. § 35-393.01

If vendor engages in for-profit activity and has 10 or more employees, and if this agreement has a value of $100,000 or more, vendor certifies it is not currently engaged in, and agrees for the duration of this agreement to not engage in, a boycott of goods or services from Israel. This certification does not apply to a boycott prohibited by 50 U.S.C. § 4842 or a regulation issued pursuant to 50 U.S.C. § 4842.

4.32 CERTIFICATION REGARDING DEBARMENT AND SUSPENSION

4.32.1 The undersigned (authorized official signing on behalf of the contractor) certifies to the best of his or her knowledge and belief that the contractor, its current officers, and directors:

4.32.1.1 are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from being awarded any contract or grant by any United States department or agency or any state, or local jurisdiction;

4.32.1.2 have not within a three-year period preceding this contract:

4.32.1.2.1 been convicted of fraud or any criminal offense in connection with obtaining, attempting to obtain, or as the result of performing a government entity (Federal, state or local) transaction or contract; or

4.32.1.2.2 been convicted of violation of any Federal or state antitrust statutes or conviction for embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property regarding a government entity transaction or contract;

4.32.1.3 are not presently indicted or criminally charged by a government entity (Federal, state or local) with commission of any criminal offenses in connection with obtaining, attempting to obtain, or as the result of performing a government entity public (Federal, state or local) transaction or contract;

4.32.1.4 are not presently facing any civil charges from any governmental entity regarding obtaining, attempting to obtain, or from performing any governmental entity contract or other transaction; and

4.32.1.5 have not within a three-year period preceding this contract had any public transaction (Federal, state or local) terminated for cause or default.

4.32.2 If any of the above circumstances described in the paragraph are applicable to the entity submitting a bid for this requirement, include with your bid an explanation of the matter including any final resolution.

4.32.3 The contractor shall include, without modification, this clause in all lower tier covered transactions (i.e., transactions with subcontractors or sub-subcontractors) and in all solicitations for lower tier covered transactions related to this contract. If this clause is applicable to a subcontractor or sub-subcontractor, the contractor shall include the information required by this clause with their bid.

4.33 VERIFICATION REGARDING COMPLIANCE WITH A.R.S. § 41-4401 AND FEDERAL IMMIGRATION LAWS AND REGULATIONS

4.33.1 By entering into the contract, the contractor warrants compliance with the Immigration and Nationality Act (INA using E-Verify) and all other Federal immigration laws and regulations related to the immigration status of its employees and A.R.S. § 23-214(A). The contractor shall obtain statements from its subcontractors certifying compliance and shall furnish the statements to the procurement officer upon request. These warranties shall remain in effect through the term of the contract. The contractor and its subcontractors shall also maintain Employment Eligibility Verification forms (I-9) as required by the Immigration Reform and Control Act of 1986, as amended from time to time, for all employees performing

work under the contract and verify employee compliance using the E-Verify system and shall keep a record of the verification for the duration of the employee's employment or at least three years, whichever is longer. I-9 forms are available for download at www.uscis.gov.

4.33.2 The County retains the legal right to inspect documents of contractor and subcontractor employees performing work under this contract to verify compliance with paragraph 4.33.1 of this section. Contractor and subcontractor shall be given reasonable notice of the County's intent to inspect and shall make the documents available at the time and date specified. Should the County suspect or find that the contractor or any of its subcontractors are not in compliance, the County will consider this a material breach of the contract and may pursue any and all remedies allowed by law, including, but not limited to: suspension of work, termination of the contract for default, and suspension and/or debarment of the contractor. All costs necessary to verify compliance are the responsibility of the contractor.

4.34 INFLUENCE

4.34.1 As prescribed in MC1-1203 of the Maricopa County Procurement Code, any effort to influence an employee or agent to breach the Maricopa County Ethical Code of Conduct or any ethical conduct, may be grounds for disbarment or suspension under MC1-902.

4.34.2 An attempt to influence includes, but is not limited to:

4.34.2.1 A person offering or providing a gratuity, gift, tip, present, donation, money, entertainment or educational passes or tickets, or any type of valuable contribution or subsidy that is offered or given with the intent to influence a decision, obtain a contract, garner favorable treatment, or gain favorable consideration of any kind.

4.34.3 If a person attempts to influence any employee or agent of Maricopa County, the chief procurement officer, or his designee, reserves the right to seek any remedy provided by the Maricopa County Procurement Code, any remedy in equity or in the law, or any remedy provided by this contract.

4.34.4 ABSOLUTELY NO CONTACT BETWEEN THE RESPONDENT AND ANY COUNTY PERSONNEL, OTHER THAN THE OFFICE OF PROCUREMENT SERVICES, IS ALLOWED DURING THE SOLICITATION PROCESS UNLESS THE COMMUNICATION IS IN REGARD TO PRE-EXISTING BUSINESS WITH THE COUNTY. ANY COMMUNICATIONS REGARDING THE SOLICITATION, ITS PARTICIPANTS, OR ANY DOCUMENTATION PRIOR TO THE CONTRACT AWARD MAY BE GROUNDS FOR DISMISSAL OF THE RESPONDENT FROM THE EVALUATION PROCESS.

4.35 CONFIDENTIALITY

In the course of the solicitation process, the County may disclose information that is proprietary or confidential. By submitting a bid to the solicitation, the offeror agrees that, except as necessary to prepare a response to this solicitation, neither it nor its agents or employees will communicate, divulge, or disseminate to any third-party persons or entities, any information that is disclosed to it by the County during the course of these discussions without the express written authorization of the County. If the offeror does disclose County proprietary or confidential information to a third party in preparing a response to this solicitation, it shall require the third party to acknowledge and comply with this provision.

4.36 CONFIDENTIAL INFORMATION

4.36.1 Any information obtained in the course of performing this contract may include information that is proprietary or confidential to the County. This provision establishes the contractor's obligation regarding such information.

4.36.2 The contractor shall establish and maintain procedures and controls that are adequate to assure that no information contained in its records and/or obtained from the County or from others in carrying out its functions (services) under the contract shall be used by or disclosed by it, its agents, officers, or employees, except as required to efficiently perform duties under the contract. The contractor's procedures and controls, at a minimum, must be the same procedures and controls it uses to protect its own proprietary or confidential information. If, at any time during the duration of the contract, the County determines that the procedures and controls in place are not adequate, the contractor shall institute any new and/or additional measures requested by the County within 15 business days of the written request to do so.

4.36.3 Any requests to the contractor for County proprietary or confidential information shall be referred to the County for review and approval, prior to any dissemination.

4.37 PUBLIC RECORDS

Under Arizona law, all offers submitted and opened are public records and must be retained by the County at the Maricopa County Office of Procurement Services. Offers shall be open to public inspection and copying after contract award and execution, except for such offers or sections thereof determined to contain proprietary or confidential information by the Office of Procurement Services. If an offeror believes that information in its offer or any resulting contract should not be released in response to a public record request, under Arizona law, the offeror shall indicate the specific information deemed confidential or proprietary and submit a statement with its offer detailing the reasons that the information should not be disclosed. Such reasons shall include the specific harm or prejudice which may arise from disclosure. The records manager of the Office of Procurement Services shall determine whether the identified information is confidential pursuant to the Maricopa County Procurement Code.

4.38 INTEGRATION

This contract represents the entire and integrated agreement between the parties and supersedes all prior negotiations, proposals, communications, understandings, representations, or agreements, whether oral or written, expressed, or implied.

4.39 UNIFORM ADMINISTRATIVE REQUIREMENTS

By entering into this contract, the contractor agrees to comply with all applicable provisions of Title 2, Subtitle A, Chapter II, Part 200—UNIFORM ADMINISTRATIVE REQUIREMENTS, COST PRINCIPLES, AND AUDIT REQUIREMENTS FOR FEDERAL AWARDS contained in Title 2 C.F.R. § 200 *et seq.*

4.40 GOVERNING LAW

This contract shall be governed by the laws of the State of Arizona. Venue for any actions or lawsuits involving this contract will be in Maricopa County Superior Court, Phoenix, Arizona.

4.41 FORCED LABOR

4.41.1 By submitting a bid for this solicitation and/or entering into a contract as a result of this solicitation, contractor agrees to comply with all applicable portions of Arizona Revised Statutes Section 35-394. Contracting; procurement; prohibition; written certification; remedy; termination; exception; definitions.

4.41.2 Contractor certifies that it does not currently, and agrees for the duration of the contract, that it will not use:

4.41.2.1 The forced labor of ethnic Uyghurs in the People's Republic of China.

4.41.2.2 Any goods or services produced by the forced labor of ethnic Uyghurs in the People's Republic of China.

4.41.2.3 Any contractors, subcontractors or suppliers that use the forced labor or any good or services produced by the forced labor of ethnic Uyghurs in the People's Republic of China.

4.41.3 If contractor becomes aware during the term of the agreement that contractor is not in compliance with this paragraph, the contractor shall notify the County within five business days after becoming aware of the noncompliance. If the contractor fails to provide a written certification to the County that the contractor has remedied the noncompliance within 180 days after notifying the County of its noncompliance, then the agreement terminates, except that if the agreement termination date occurs before the end the 180-day period, the agreement terminates on the agreement termination date.

4.42 UNIQUE ENTITY IDENTIFIER (UEI) AND SYSTEM FOR AWARD MANAGEMENT REGISTRATION

All contractors that receive funding must have a UEI number through https://sam.gov/content/entity-registration. Contractor must also remain current with the System for Award Management www.sam.gov throughout the term of the contract.

4.43 RELIGIOUS ACTIVITIES

The contractor agrees that costs, planned or claimed, including costs incurred, shall not include any expense for any religious activity.

4.44 POLITICAL ACTIVITY PROHIBITED

None of the funds, materials, property, or services contributed by the County or the contractor under the agreement shall be used in the performance of this agreement for any partisan political activity, or to further the election or defeat of any candidate for public office.

4.45 EQUAL EMPLOYMENT OPPORTUNITY

4.45.1 The contractor shall not discriminate against any employee or applicant for employment because of race, age, disability, color, religion, sex, or national origin. The contractor shall take affirmative action to ensure applicants are employed and that employees are treated during employment without regard to their race, age, disability, color, religion, sex, or national origin. Such action shall include but is not limited to the following: employment, upgrading, demotion or transfer, recruitment, or recruitment advertising, lay-off or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship.

4.45.2 Contractor shall comply with the following provisions:

4.45.2.1 Title VI and VII of the Civil Rights Act of 1964, as amended (42 U.S.C. §§ 2000a, et seq.);

4.45.2.2 The Rehabilitation Act of 1973, as amended (29 U.S.C. §§ 701, et seq.);

4.45.2.3 The Age Discrimination in Employment Act of 1967, as amended (29 U.S.C. §§ 621, et seq.);

4.45.2.4 The Americans With Disabilities Act of 1990 (42 U.S.C. §§ 12101, et seq.); and Arizona Executive Order 2009-09, as amended, et seq. which mandates that all persons shall have equal access to employment opportunities.

4.45.2.5 Contractor understands that the United States has the right to seek judicial enforcement of this assurance.

4.46 CERTIFICATION REGARDING LOBBYING

4.46.1 Contractor certifies, to the best of their knowledge and belief, that:

4.46.1.1 No federal appropriated funds have been paid or will be paid, by or on behalf of the contractor, to any person for influencing or attempting to influence an officer or employee of any agency. This applies to a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any federal grant. Including the making of any federal, loan the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any federal contract, grant, loan, or cooperative agreement.

4.46.2 If any funds other than federal appropriated funds, have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with this federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, “Disclosure Form to Report Lobbying,” in accordance with its instructions.

4.46.3 Contractor shall include Lobbying Certification language in the award documents for all subcontractors (including sub-grants, and contract under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

4.46.3.1 The Lobbying Certification is a material representation of fact upon which reliance was placed when this transaction is made or entered into. Submission of this certification is prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any successful proposer(s) who fail to file the required certification shall be subject to a civil penalty of not less than $10,000.00 and not more than $100,000.00 for each such failure.

4.47 CLEAN AIR ACT & CLEAN WATER ACT

Contractor must comply with all applicable standards, orders, or requirements issued under section 306 of the Clean Air Act (42 U.S.C. 1857(h), section 508 of the Clean Water Act (33 U.S.C. 1368) Executive Order 11738, and Environmental Protection Agency regulations (40 CFR part 15).

4.48 ENERGY POLICY AND CONSERVATION ACT

Contractor must adhere to the standards and policies relating to energy efficiency, which are contained in the State energy conservation plan issued in compliance with the Energy Policy and Conservation Act (Pub. L. 94-163, 89 Stat.871).