SP-231011
(New)

SPECIAL PROVISIONS
FOR
ITS INFRASTRUCTURE

Polk County
STP-U-1945(872)--70-77

Effective Date
December 19, 2023

THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

Sections 2525 and 4189 of the Standard Specifications are modified by these specifications.

2525.01 DESCRIPTION.

B. Submittals. (Add the following Article)

1. Schedule of Unit Prices.
a. See **Attachment A** for schedule of unit prices:

D. Related Specifications and Standards. (Add the following Article)
Unless otherwise specified in the contract documents the traffic signal installed under this special provision shall comply Specifications of the Underwriters Laboratories Inc.

E. Local Requirements. (Add the following Article)

1. The Contractor shall notify and receive approval from the City prior to any operational shutdown of any existing traffic signal installation. Adherence to the City Electrical Code shall be required for service to the controller.

2. The Contractor is responsible for locating all equipment installed as part of the project within the City right-of-way until project acceptance. Any damage as a result of failure to locate this equipment shall be the responsibility of the Contractor to replace with no additional cost to the City.

3. The Contractor shall receive delivery of traffic signal poles and equipment and assumes responsibility for delivery and installation in the field.

4. Contractor shall provide to the City “as-built” plans that identify all changes made to the contract plans.

5. Areas disturbed by construction shall be restored to their original condition at the Contractor’s expense.

F. Removals. (Add the following Article)

1. All existing traffic signal pole foundations that become unused for the new traffic signal shall be removed. Foundations 3 feet or less in depth shall be removed completely. Foundations greater than 3 feet in depth shall be removed to 3 feet below grade. All existing traffic signal handholes that become unused for the new traffic signal shall be removed and disposed of by the Contractor. Unless otherwise indicated on the plans, all existing wiring/fiber optic cables that becomes unused in this project shall be removed and disposed of by the Contractor. All holes shall be filled and surface restored.

2525.03 CONSTRUCTION.

A. Underground.

2. Conduit.

a. General.

1) (Replace the following Article) Conduit buried in open trenches shall be placed a minimum of 36 inches deep and a minimum of 2 feet from the back of curb unless otherwise directed by the Engineer. Open trench methods of placing conduit will be permitted except where the conduit is to be placed under existing pavement. Conduit in pavement areas shall be placed to a minimum depth of 48 inches below the finished pavement surface or as directed by the Engineer.

7) (Add the following Article) When underground conduits parallel an existing facility, maintain at least 1 foot of separation.

8) (Add the following Article) Proof all conduit upon completion to verify continuity and integrity of the duct.

9) (Add the following Article) Each conduit shall include one pull tape and tracer.

10) (Add the following Article) Locate all new conduits until project acceptance.

3. Wiring and Cable.

a. (Replace the following Article) Each vehicle and pedestrian signal head shall have a separate cable from the signal head to the pole base. A 7-conductor cable shall be used for all four or five section vehicle heads. A 5-conductor cable shall be used for all three section vehicle heads unless otherwise specified in the plans. All signal head cables shall be spliced in the pole base and/or signal cabinet, unless specified otherwise on the plans. Within the cabinet, all signal cables shall be labeled as to their direction of origin. All splices in the handhole compartment of a signal pole shall be made using silicone filled, screw-on wire connectors. Wires shall be twisted before the connector is added. Cable connections in signal heads and controller cabinets shall be made at the terminal blocks provided for that purpose, without using crimp-on connectors.

b. (Replace the following Article) Coil 50 feet of power service cable at the base of the secondary service pole. The Contractor is responsible for coordinating power service locations with MidAmerican Energy at the onset of the project, prior to conduit/cable installation. The Contractor is responsible for the cost of the secondary service riser installed by MidAmerican Energy and all associated power service connection costs and fees until acceptance of the project. Meter to be installed onto side of the traffic signal controller cabinet; the meter socket to be a 200A with by-pass.

c. (Replace the following Article) A continuous orange tracer wire (1c #10) shall be included from each quadrant to the controller cabinet. A separate orange tracer wire (1c #10) shall

be included in all conduits with all fiber optic communication cable. A yellow tracer wire shall be used in conduits with only streetlight circuits. Tracer wire for the signal system shall terminate on a terminal block with connection points in the controller cabinet and shall be labeled with the quadrant of origin. Tracer wire for the communication/fiber system shall terminate in the locate box and list direction. The Contractor shall install, splice, and test the tracer wire for continuity. Every tracer wire run shall be grounded at one end.

i. Fiber Optic Cable and Accessories.

9) (Add the following Article) At each handhole or through point and at the cabinet, visibly and durably mark or tag the cable with the type of cable (single mode or multi-mode), the fiber count, and "FIBER OPTIC CABLE, CITY OF DES MOINES". Additionally, mark each cable mark with the adjacent intersection of origin and destination. In cases where cables are spliced in a splice enclosure only the intersection of origin is needed.

Example:

FIBER OPTIC CABLE, CITY OF DES MOINES 48 FIBER – SM EAST – 63rd & HICKMAN WEST – WESTOVER & HICKMAN

10) (Add the following Article) Leave slack in each handhole, at the top of any conduit riser, in each junction box, in each controller cabinet, and at each equipment rack or other point of termination. Unless otherwise specified, slack in handholes shall be 100 feet in Type III and Type IV handholes, 50 feet in Type I and Type II handholes, and 10 feet in 18 inch handholes. This slack cable requirement may be deleted where existing handholes or through points lack sufficient area to maintain the minimum bend requirements. Where slack has been deleted, extra slack equal to the amount that would have been distributed in the through points shall be equally divided between the two controller cabinets and shall be in addition to the slack mandated at the cabinets. Coil slack cable and bind at three points around the coil perimeter.

11) (Add the following Article) Terminate all fibers in the fiber optic termination unit, unless stated otherwise in the plans. Unless otherwise specified, mount the enclosure on an EIA 19 inch rack in an area that does not interfere with the normal maintenance of the cabinet electronics. Secure the field cable to the enclosure in a manner that does not degrade the fiber optic cable but ensures a firm and secure mount. Coil sufficient lengths of every loose fiber within the enclosure to provide spare distance and reach the fiber interface panel. Spiral wrap each individual fiber in the fan out kit. Label each fiber on the bulkhead by direction and intersection of origin.

Example:

A – North B – South – 63rd & Univ. C – East – MH & Hick. D - West

j. Fiber Optic Cable Field Testing. (Replace with the following Article)

1) Visually inspect fiber-optic cable prior to installation. Report any defects to the Engineer.

2) Pre-acceptance of fiber (on-reel), test all strands of fiber (uni-directional) with an Optical Time Domain Reflectometer (OTDR) at 1310 nm and 1550 nm to verify attenuation, continuity and length of the cable. Measured length by the OTDR shall match manufacturer cable foot markings plus manufacturer provided helicity. Provide the Engineer with a PDF copy of the OTDR traces. Fiber test results submitted to the Engineer that exceed the max attenuation loss specification will be identified as Out of Specification.

3) Test all strands of fiber per the contract documents with an OTDR at 1310 nm and 1550 nm to verify attenuation, continuity, and length of the cable. Measured length by the OTDR shall match manufacturer cable foot markings plus manufacturer provided helicity. Measured post installation length shall match pre-installation (on-reel) length +/- 50 feet for each strand. Provide the Engineer with a PDF copy of the OTDR traces. Fiber test results submitted to the Engineer that exceed the max attenuation loss specification will be identified as Out of Specification.

4) The fiber-optic cable is to have a maximum attenuation of 0.4 dB/km at 1310 nm and 0.3 dB/km at 1550 nm when measured with an OTDR. Fiber test results submitted to the Engineer that exceed the max attenuation loss specification will be identified as Out of Specification.

5) Replace, as directed by the Engineer, any defect discovered during final acceptance at no additional cost to the Contracting Authority. Consider a defect to be any cable with an OTDR measured length that differs from the actual cable footage, excluding manufacturer's helicity.

6) All test equipment shall be factory certified within the last year. Provide copies of the certification 10 calendar days prior to testing.

7) Record test results with data compiled in PDF format through the meter manufacturer's software. No additional alteration using software beyond the meter manufacturer's software will be allowed. Submit test results in a format approved by the Engineer. Submit completed test forms on each fiber to the Engineer. Provide native test (electronic version) with no alterations and meter software for viewing of fiber traces. At a minimum, test results shall show the following:

- Cable and fiber identification (as approved by the Engineer).
- Operator Name.
- Date and Time.
- Setup and test parameters including wavelength, pulse width, range, scale and ambient temperature.
- Test results for OTDR test in both directions for total fiber trace, splice loss/gain (dB), connector loss (dB), all events greater than 0.05 dB, measured length from cable markings and total length from OTDR.
- Test results for attenuation test including measured cable length (cable marking), total length (from OTDR test), number of splices (from as-built) and total link end-to-end attenuation in each direction and the bidirectional average.

8) OTDR testing shall use a launch and receiving cable. Each cable shall be a minimum 3290 feet, or greater than the dead zone for the OTDR used for this test, whichever is larger.

k. Fiber Optic Splicing Acceptance Testing (Add the following Article)

1) Post splicing, test termination to termination per the contract documents with an OTDR at 1310 nm and 1550 nm to verify attenuation and continuity of strands for the entire length of cable. Provide the Engineer with up to two copies of any software required for viewing electronic files of the OTDR traces.

2) Each splice is to have an averaged loss value of 0.07 dB or less when measured bi-directionally with an OTDR at 1310 nm and 1550 nm. Splice test results submitted to

the Engineer that exceed the 0.07 dB or less specification will be identified as Out of Specification.

3) Each connector is to have an averaged loss value of 0.25 dB or less when measured bi-directionally with an OTDR at 1310 nm and 1550 nm. Connector test results submitted to the Engineer that exceed the max loss of 0.25 dB specification will be identified as Out of Specification.

4) All test equipment shall be factory certified within the last year. Provide copies of the certification 10 calendar days prior to testing.

5) Record test results with data compiled in PDF format through the meter manufacturer's software. No additional alteration using software beyond the meter manufacturer's software will be allowed. Submit test results in a format approved by the Engineer. Submit completed test forms on each fiber to the Engineer. Provide native test (electronic version) with no alterations and meter software for viewing of fiber traces. At a minimum, test results shall show the following:

- Cable and fiber identification (as approved by the Engineer).
- Operator Name.
- Date and Time.
- Setup and test parameters including wavelength, pulse width, range, scale and ambient temperature.
- Test results for OTDR test in both directions for total fiber trace, splice loss/gain (dB), connector loss (dB), all events greater than 0.05 dB, measured length from cable markings and total length from OTDR.
- Test results for attenuation test including measured cable length (cable marking), total length (from OTDR test), number of splices (from as-built) and total link end-to-end attenuation in each direction and the bidirectional average.

6) OTDR testing shall use a launch and receiving cable. Each cable shall be a minimum 3290 feet, or greater than the dead zone for the OTDR used for this test, whichever is larger.

l. (Add the following Article) Provide and install all wiring and luminaires as shown in the plans. Connect the cables in the pole to the intersection lighting cable using fused connectors. Breakaway, fused connectors shall be used for all connections.

4. Footings and Foundations.

b. Foundation.

1) Forms.

c) (Replace the following Article) When installed in an unpaved area, shape the top 11 inches of the foundation to be square and set the top of the foundation 2 inches above the surface of the ground.

d) (Add the following Article) The Contractor shall be responsible for the proper elevation, offset, and level of each foundation.

d. Modifications: (Add the following Article) When installing a conduit bend in an existing base the conduit size shall be equivalent to the conduit in the ground. The steel in the base shall not be cut or damaged and the concrete shall be broken away in the shape of a "U" with an approximate depth of at least 12 inches below the depth of the surrounding ground surface. Enough concrete shall be removed so the conduit will be inside the anchor bolts of the foundation. The conduit shall be placed in the "U" with concrete added in the "U" and finished to match the base.

5. Bonding and Grounding. (Add the following Articles)

f. Metal conduit, service equipment, anchor bolts, metal poles, pedestals, controller cabinets, interconnect cable shields, and all other electrical equipment shall be made mechanically and electrically secure to form a continuous system, and shall be effectively grounded. The grounding conductor shall be a No. 6 AWG copper, non-insulated wire. The ground wire shall be installed in all conduits with the exception of the 1 inch conduit

between the detector loops and the handhole, and any conduit containing only detector lead-in cable or fiber.

g. Grounding shall be accomplished by bonding the grounding circuits to copper clad metal, driven electrodes. The electrodes shall be driven vertically until the top of the rod is minimum of 4 inches below grade. Bonding to the ground rod shall be made by means of suitable screw type positive ground rod clamps. The controller cabinet ground shall measure 10 ohms or less.

h. Grounding to existing water lines will not be permitted.

i. Bonding of standards and pedestals shall be by means of a bonding strap attached to an anchor bolt or to 1 inch, or longer, brass or bronze bolt installed in the lower portion of the shaft.

j. The service meter and socket shall be bonded to a ground electrode by use of a ground clamp and a No. 6 AWG copper wire.

k. Bonding of metallic conduit in concrete pull boxes and manholes shall be by means of galvanized grounding bushings and bonding jumpers. Where there is a change, at a pull box or manhole, from non-metallic conduit to metallic conduit, the grounding wire in the non-metallic conduit shall be bonded to the metallic conduit. Saddle clamps are not acceptable.

l. Existing ungrounded metal poles on which cabinets are mounted shall be grounded by means of a driven ground rod.

m. The interconnect cable shield shall be bonded to the controller ground buss at one controller termination point for each interconnect run.

B. Detection.

1. Detector Loop Cable Installation. (Replace the following Article)

d. Install detector loop cable without damage. Place three turns of the detector loop cable into the saw cut, unless otherwise specified in the plans. Seal the ends of the tubing at the time of placement to prevent entrance of moisture.

D. Cabinet and Controller.

1. Cabinet (Add the following Articles)

c. The aluminum rack edge shall be labeled for each detector amplifier, load switch, and isolator.

d. The cabinet shall be oriented with the back of the cabinet toward the intersection such that the signal heads can be viewed while facing the controller unless otherwise directed by the project engineer.

E. Poles, Heads, and Signs.

1. Vehicle and Pedestrian Traffic Signal Heads. (Add the following Article)

e. All mast-arm mounted traffic signal heads shall have backplates. Universally adjustable brackets and cable banding shall be used to mount all pole-mounted and mast arm-mounted overhead signals. All overhead displays located on each mast arm shall have each red indication set at approximately the same elevation, unless otherwise directed by the Engineer. All optically limited signal heads shall be properly masked to limit their field of view as directed by the Engineer.

L. Painting. (Add the following Article)

1. If the painted surface of any equipment is damaged in shipping or installation; such equipment shall be retouched or repainted in a manner satisfactory to the Engineer.

4189.01 UNDERGROUND.

C. Wiring and Cable.

5. Fiber Optic Cable and Accessories (Replace the Article)

a. The cable shall meet the latest applicable standard specifications by ANSI, EIA and TIA for the single-mode fiber cable of the size specified per the Plans.

b. Provide the Engineer the manufacturer's production test provided with the spool.

c. Provide the Engineer with documentation of wasted cable.

d. The buffer tubes shall be compatible with standard hardware and shall have 12 fibers per tube, the fibers shall not adhere to the inside of the buffer tube, each fiber shall be distinguishable by means of color coding in accordance with TIA/EIA-598-B "Optical Fiber Cable Color Coding" and be colored with ultraviolet (UV) curable ink.

e. The cable core shall be water blocked with dry water blocking materials to improve access and handling of individual tubes.

f. The cables shall be designed for point-to-point applications as well as mid-span access and provide a high-level of protection for fiber installed in the outside plant environment.

g. The optical fiber shall be fully capable of handling existing and legacy single-mode applications which traditionally operate in the 1310 nm and 1550 nm regions and shall also be designed to operate the full-spectrum from 1260 nm to 1625 nm for optical transmission.

h. The optical fiber shall be designed to provide optimum performance from 1260 nm to 1625 nm intended for 16 channel Course Wavelength Division Multiplexing applications.

i. The optical fiber shall be manufactured by Corning, OFS or Draka.

j. The MDPE jacket material shall be as defined by ASTM D1248, Type II, Class C, Category 4 and Grades J4, E7 and E8.

k. The jacket or sheath shall be free of holes, splits, and blisters.

l. Cable jackets shall be marked with the manufacturer's name, month, and year of manufacturer, sequential foot markings, the symbol for communication cable as required by Section 350G of the NESC, fiber count, and fiber type. The actual length of the cable shall be within -0/+1% of the length markings. The print color shall be white, with the exception that cable jackets containing one or more coextruded white stripes, which shall be printed in light blue. The height of the marking shall be approximately 2/16 inches.

m. The maximum pulling tension shall be 600 pounds during installation (short term) and 200 pounds installed (long term).

n. The shipping, storage, and operating temperature range of the cable shall be -40°F to 158°F. The installation temperature range of the cable shall be -22°F to 158°F.

o. Single-Mode, Fiber-Optic OSP Cable – Dielectric Loose Tube.

1) Fiber-optic, single-mode, graded loose tube dielectric cable constructed with industry standard 3 mm buffer tubes stranded around a central strength member.

2) Single-mode, dispersion-unshifted fiber meeting ITUT G.652D requirements.

3) Cables shall be sheathed with MDPE. The minimum nominal jacket thickness shall be 1.3 mm. Jacketing material shall be applied directly over cable core and water swellable tape. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

4) The cable jacket shall contain no metal elements and shall be of a consistent thickness.

p. Single Panel Housing (Holds One Connector Panel and Splice Organizer).

1) Surface mounted termination/splice housings shall provide for termination capabilities, splice protection and associated fiber/pigtail storage.

2) Surface mount housing shall be intended for splicing and management, and cross-connect or both for up to 12 fibers.

3) Termination adaptor panels shall be duplex LC.

4) Top and bottom cable entry grommets for incoming fiber, fiber jumper.

5) Manufactured of metal.

6) Hinged front door, universal mounting brackets, jumper bend limiters and labels for identifying fiber terminations.

7) Wall mountable single panel housing shall be Corning SPH-01P and CCH adaptor panel or approved equal. Adapter Bracket shall be AFL part #FM001636, or approved equal.
8) Splice cassettes shall be AFL Poli-Mod Patch and Splice Module splice cassettes (part # PM-L-12-ULC-0-S-01), or approved equal.

q. UPC/LC Factory Terminated Fiber Connector and Pigtails (Include Splice and Connector Sleeve).

1) All fiber connectors used on this project, including in shelves, cabinets or panels, shall be factory installed connectors.
2) No field terminated connectors will be allowed.
3) Connectors shall be LC/UPC having a typical insertion loss (single-mode) of 0.15 dB or less, a maximum loss of 0.35 dB or less, with typical reflectance of -55 dB and temperature stability from -40°F to 167°F.
4) Pigtails fiber must be of the same manufacturer as the main fiber cable.
5) Pigtails shall be rated for the environment in which they are installed.
6) Pigtails shall be spliced in accordance with the splicing specifications and in fiber shelves or panels using manufacturer splice organizers.

r. Fiber Optic Jumpers/Patch Cords: For connections in the cabinet, provide factory-assembled duplex pigtail jumpers with dielectric strength member, durable outer jacket and ST or SC compatible connectors. Provide adequate length for connections and 2 feet minimum slack.

s. Fiber Optic Breakout Kits: Provide breakout kits for separation and protection of individual fibers, with buffering tube and jacketing materials suitable for termination of the fiber and fiber optic connector.

t. Outside Plant (OSP) Fiber Splice Closures.

Fiber optic cable runs shall be continuous without splice between controller cabinets, unless otherwise specified. Ends of continuous fiber cable runs and/or traffic signal controller branch circuit points will be fusion spliced in an outside plant splice enclosure located in handholes as shown on plans.

1) Environmental protection of cable and splices designed for water submersion, underground installation and splicing in handholes.
2) Shall be compatible with all sizes of fiber cables used on this project and large enough to accommodate the number of splices plus 10%.
3) The closures shall be a dome type manufactured from a high-density polyethylene or approved equivalent nonmetallic material with the following properties:
   a) Cable entry shall be manufactured of similar material to the dome body and seal the closure with re-usable compressed gel cable sealing components that accommodate a wide range of cable sizes.
   b) Closures shall be re-enterable and re-sealable without the need for specialized tools or equipment or any additional parts.
   c) No encapsulated materials shall be allowed.
   d) Be provisioned for a minimum of six cable entries.
   e) Hinging splicing trays that provide controlled access to splices and slack storage.
   f) Splice and storage compartments accessible via a removable dome-clamp system.
   g) Allow for the storage of at least eight unopened buffer tubes.
4) Shall contain all splice trays, storage, splice sleeves, organizing materials, and any other incidental materials required to complete.
5) Shall be Commscope FOSC450-BS-6-NT-0-B-0-V.
6) Splice trays shall be Commscope # 429567-000.
7) It is recommended that splice sleeves are Commscope # SMOUV.
8) After splicing is complete, the fiber optic cable and closure shall be flash tested for leaks.
9) MetroNet new splice enclosures if required would need to be FOSC450B – Next size larger

u. Fusion Splices.

1) Fusion splices shall be used to splice all continuous fiber runs in splice closures and factory terminated connector pigtails.
2) Shall only be allowed in the splice closures and locations as shown on the plans.
3) Maximum attenuation per splice as estimated by the fusion splicer shall not exceed 0.02dB. Any splice exceeding 0.02 dB at the time of splicing shall be re-spliced.
4) Splice shall provide three axis core alignment using light injection and loss measurement techniques.
5) No mechanical splices of fiber cable will be allowed.
6) All fusion splice equipment shall be factory serviced within the last year. The Contractor shall provide copies of factory service 10 days prior to splicing.
7) Maintain on site at all times all materials necessary to immediately make temporary and/or permanent repairs to active fiber damaged during the course of work, including availability of additional splicing equipment.

6. **Pull Tape.** (Add the following Article) All conduit shall include one, 1/2 inch wide, polyester cable pulling tape with a minimum 1200 pound tensile strength when installation is complete. All conduits shall include a tracer wire as specified in the Wiring and Cable section.

4189.02 DETECTION. (Add the following Articles)

A. Inductive Loop Vehicle Detector: All loop detectors in new pavement shall be preformed. No saw-cut loops will be accepted in new pavement.

1. **Cables.**
   c. Loop Detector Lead-In Cable: Detector lead-in cable shall be No. 14 AWG.

B. Pedestrian Push Button Detectors.

5. **Construction:** Pedestrian pushbuttons shall be of the push type without levers, handles, or toggle switches. Each pushbutton shall consist of a solid state electronic switch with no moving plunger or moving electrical contacts. The case shall have one outlet for a 1/2 inch pipe. The operating button shall be made of stainless steel and shall be of sturdy design. This button shall not protrude out from the case. The entire assembly shall be weather tight, secure against electrical shock and of such construction as to withstand continuous hard usage. The contact shall be normally open and no current flowing except at the moment of actuation. The pushbuttons supplied shall be ADA accessible pushbutton assembly with momentary LED indicator. The pushbutton casing shall be black in color, with a raised directional arrow.

6. **Construction:** When APS pushbuttons are specified in the plans they shall meet the following specification. Pushbutton assembly shall be black in color, have an integrated R10-3 sign and ADA compliant pushbutton with raised directional arrow. The pushbutton shall provide confirmation through latching LED light, sound and tactile bounce. Pushbutton shall provide both sounds and message options during the WALK interval as well as vibration, sounds during the clearance interval, adjustable volume locator tone during the DON'T WALK interval, direction of travel messages, and special messages determined by the user. The pushbuttons shall have a control unit that mounts in the controller cabinet to operate all pushbuttons for the intersection. All wiring and components to create a functional system are included in the unit price for this item.

E. Inductive Loop Bicycle Detector: Refer to Article 4189.02, A of the Standard Specifications

4189.04 CABINET AND CONTROLLER.

A. NEMA Controller, Cabinet, and Auxiliary Equipment: Delete reference to NEMA Standards.

1. **Controller:** (Replace the following Articles) This part consists of the equipment requirements necessary for furnishing a 2070 Advanced Traffic Controller (ATC) system with a 1C CPU module and vendor matching traffic signal Controller Local Software (CLS) as described in the project plans and these special provisions.
   a. **Related Specifications and Standards:** Unless otherwise specified in the project plans and special provisions the 2070 ATC system furnished and installed under this specification shall comply with:
      1) California Department of Transportation (Caltrans) TEES 2009 with Errata
      2) Caltrans Qualified Products List
      3) Institute of Transportation Engineers (ITE) ATC Standard 5.2b
      4) NTCIP Base Standards
      5) National Electrical Code.
      6) MUTCD latest edition.
   b. **General Specifications.**
      1) Equipment Certification.
      The Contractor shall furnish the Engineer with a certification from the equipment manufacturer or supplier stating that the equipment furnished under this specification complies with all provisions of this specification. With prior approval of the Engineer, minor exceptions to this specification may be allowed, provided these exceptions are detailed on the certification.
      2) Warranty.
      All 2070 ATC controllers and auxiliary equipment furnished under this specification shall be provided with a standard industry warranty. Any parts found to be defective shall, upon concurrence of the defect by the manufacturer, be replaced free of charge.
      3) Delivery and Coordination.
         a) A minimum of 1 week prior to the scheduled “turn-on”, the Contractor shall deliver the necessary components to the Traffic Signal Shop located at 1551 E Martin Luther King Jr Parkway. It is the responsibility of the Contractor to call ahead to schedule delivery.
         b) The City of Des Moines will install the 1C CPU module and verify the specified software and timings. Should any controllers be found faulty at the shop, the Contractor will be contacted. The Signal Shop is not responsible for trouble shooting this equipment nor is any part of this process intended to replace “burn-in” responsibility of the manufacturer.
         c) The Contractor is responsible for picking up the controller(s) from the Signal Shop and is solely responsible for bringing the controller(s) to full operation at the intersection(s). No assistance will be provided by the Signal crew once the software is working correctly and the signal timings have been verified in the Signal Shop. Having a knowledgeable representative at the project site(s) when the controller(s) is ready to be turned on is paramount to the safety and efficiency of this operation.
   c. **Controller Chassis.**
      1) The ATC Controller Chassis shall comply with TEES 2009 with latest Errata and be listed on Caltrans Qualified Products List. The product shall be McCain 2070LX or Engineer approved equal.
      2) Controller Chassis shall be equipped with Linux Operating System with serial motherboard.
      3) ATC Controller Chassis Microprocessors shall be Freescale Power QUICC II Pro.
      4) ATC Controller Chassis shall include the following memory:
         a) 16MB Flash memory
         b) 128MB DDR RAM (expandable)
         c) 2MB Non-volatile SRAM
      5) ATC Controller Chassis shall include Backup Real-Time Clock (RTC).
      6) ATC Controller Chassis shall include the following Communication Interfaces:
         a) Two SDLC ports

b) Four asynchronous Serial ports
c) ENET 1: 100 Base-T Ethernet switch, one uplink port, and three additional ports
d) ENET 2: 100 Base-T Ethernet port dedicated for local communications
e) Two USB ports

7) ATC Controller Chassis shall include a Front Panel Interface with:
a) One Display: 8 lines by 40 characters
b) One Keyboard: 3 by 4 navigation and 4 by 4 data entry keypads

8) ATC Controller Chassis shall include the following Cabinet Interfaces:
a) Rear Connections: TEES C1S, C11S, C12S

9) ATC Controller Chassis dimensions shall be 7 inches H by 19 inches W by 13 inches D and shall be EIA rack mount compatible.

10) ATC Controller Chassis power requirements shall be: 89 VAC to 135 VAC, 60 Hz (±3 Hz).

11) ATC Controller Chassis shall be capable of operating in the following environment:
a) Temperature: -35°F to 165°F
b) Humidity: 0 to 95% (non-condensing)

d. Controller Modules: 2070 ATC System shall be furnished with the 2070 ATC Controller Modules listed within this section.

1) ATC Controller Modules shall comply with TEES 2009 form factor for 2070 components.

2) ATC Controller Modules shall be capable of operating in the following environment:
a) Temperature: -35°F to 165°F
b) Humidity: 0 to 95% (non-condensing)

3) I/O Module shall be 2070-2E for Caltrans 170/2070 cabinets. I/O Module shall comply with TEES 2009 with latest Errata and be on Caltrans Qualified Products List.

4) Front Panel Display shall be 2070-3B small font LCD panel module with 8 lines x 40 characters, 3 by 4 navigation keypad, 4 by 4 data entry keypad.

5) Power Supply Module shall be 2070-4A. Power Supply Module shall comply with TEES 2009 with latest Errata and be on Caltrans Qualified Products List.

e. Controller Local Software (CLS): 2070 ATC 1C CPU module and CLS shall be furnished by the Contractor with the McCain Omni EX software (version 1.11.3 or approved alternate). The 1C CPU module and software will include the following functions/features:

1) Phases.
a) 16 volume/density vehicle phases
b) 16 pedestrian phases
c) Four rings
d) Automatic barrier calculation based on compatible phases
e) Variable phase sequence
f) Exclusive pedestrian-phase operation
g) Alternate timing for special vehicles, bicycles or pedestrians
h) Advanced and delayed walk
i) Texas diamond operation
j) 32 output channels
k) Four unique sets of phase timing and options selectable by pattern

2) Overlaps.
a) 16 vehicle overlaps
b) 16 pedestrian overlaps
c) Negative (excluded) vehicle and pedestrian phases
d) Delayed start of green
e) Flashing yellow or red arrow overlaps
f) Detector call phases and locking
g) Four unique sets of overlap configurations selectable by pattern

3) Coordination.
a) 250 free or coordinated patterns
b) Automatic or manual permissive

c) Fixed or floating force off
d) Reference beginning or end of green
e) Change virtually all operational parameters by pattern
f) 16 phase sequence selection by pattern

4) Cabinet Inputs and Outputs.
a) Support all cabinet types
b) Individually assignable input and output functions (I/O mapping)
c) Internal multi-input Boolean logic gates with delay, extend and latch, and flashing output features
d) 16 generic alarm inputs
e) 16 special functions
f) External pattern selection
g) Pulsing preempt and transit priority input discrimination

5) Detection.
a) 128 local/system detectors
b) Single or dual detector speed calculation
c) Phase assignments configurable per detector, multiple phases per detector
d) Direct detector actuation for vehicle and pedestrian overlaps
e) All NTCIP detector options
f) Delay and extend timing
g) Alternate passage, minimum green and pedestrian timing detection
h) Vol/Occ configurable per detector
i) Detector failure monitoring configurable by time-of-day
j) Connect directly to video detection

6) Communications.
a) Support all industry standard communication
b) Fully NTCIP 1201 and 1202 compliant (mandatory and optional objects)
c) NTCIP MIB and block objects for all vendor-specific parameters
d) Data validation during download
e) Network time client and/or server
f) GPS, WWV, NMEA, and NTP time synchronization
g) California AB3418E with master function for time and patter broadcast
h) USB for database upload/download, firmware upgrades, log retrieval
i) Peer to peer sharing of I/O between intersections
j) Web browser support
k) Connected vehicle SPaT interface

7) Preemption.
a) Eight preemption sequences
b) Each sequence configurable for railroad or emergency vehicle operation
c) Definable priority and linking
d) User configurable overlap enable/disable during all preempt intervals
e) Flashing and limited service options
f) User assignable status options

8) Transit Priority.
a) Estimated time of arrival
b) 16 priority strategies in four sets, selectable by pattern
c) Options to support any type of vehicle detection
d) Configurable headway and preempt lockout times
e) Queue jump
f) Intelligent phase time adjustment based o expected vehicle arrival
g) Remotely actuation or enable/disable of priority strategies
h) Support for user configurable special logic and advanced operations
i) Programmable logic for advanced TSP applications

9) Time-of-Day Scheduler.
a) 64 schedule
b) 64 day plans

c) 48 events
d) 128 actions
e) Operational parameters changeable by time-of-day

10) Logs.
a) High resolution logging
b) Extensive event log for management and diagnostic purposes
c) Cycle-based measures of effectiveness
d) Detector volume, occupancy and speed
e) Speed trap data
f) NTCIP global reporting conformance group for user-defined event logging
g) User access logs

Any modifications to this specification or production shall be reviewed and approved by the Engineer.

2. Cabinet.

a. (Replace the following Article) When specified, the Model 332A or Model 332D Cabinet furnished for the project shall meet the requirements of Chapter 11 "Specifications for Cabinet Model 332A," and the Model 336 Cabinet shall meet the requirements of "Specifications for Cabinet Model 336" dated February 1982, except that the color specified in Section 1, paragraph 3 shall be changed to silver. Molex Flash Blocks shall be provided for all eight vehicle phases to program either red or yellow flashing indications. A detector input panel shall be provided on the rear left side of the cabinet. Cabinet locks shall Corbin Type 2 locks. An aluminum cabinet shall be furnished. The aluminum surface shall have an anodic coating applied. The anodic coating and anodic coating process shall meet the requirements of Section 2.4.1 and 2.4.2 of the "Traffic Signal Control Equipment Specifications," California Business, Transportation and Housing Agency, Department of Transportation, January 1989. Alternative aluminum surface treatments, which produce an equivalent uniformly textured surface, may be substituted as approved by the Engineer.

i. (Replace the following Article) Each cabinet shall be provided with devices to protect the control equipment form surges and over voltages. This shall include incoming power lines, the Input File, the Output File, and communication lines. Each inductive loop detector input wire shall be protected with a 30V MOV with (30 Joule Rating) P/n ERZ-C20 KE 470 or equal. The output of all load switch outputs shall be protected with a 150V MOV (80 Joule Rating). P/n ERZ-C20 DK 241U or equal. The MOVs shall be connected from the AC positive field terminal to the chassis ground. For the 332A or 332D cabinet, appropriate input surge protection shall be mounted on the Lower Input Termination Panel (LIP). The power distribution assembly (PDA#2) of each controller cabinet shall include a surge protection unit on the AC Service Input. The protector shall be installed between the applied line voltage and earth ground. The surge protector shall be capable of reducing the effect of lightning transient voltages applied to the AC line. The protection device shall be a two stage series parallel device. It shall include the following features and functions:

1) Maximum AC line voltage: 140 VAC.
2) Twenty pulses of peak current, each of which will rise in 8 microseconds and fall in 20 microseconds to 1/2 the peak: 20,000 Amperes.
3) The protector shall be provided with the following terminals:
a) Main line (AC line first stage terminal).
b) Main Neutral (AC Neutral input terminal).
c) Equipment Line Out (AC Line second stage output terminal, 10 Amps.).
d) Equipment Neutral Out (Neutral terminal to protected equipment).
e) GND (Earth connection).
f) The Main AC line in and the Equipment Line out terminals shall be separated by a 200 Microhenry (minimum) inductor rated to handle 10 Amp AC Service. The first stage clamp shall be between Main Line and Ground terminals.

g) The second stage clamp shall be between Equipment Line out and Equipment Neutral.
h) The protector for the first and second stage clamp must have a MOV or similar solid state device rate at 20 KA and be of a completely solid stage design (i.e., no gas discharge between tubes allowed).
i) The Main Neutral and Equipment Neutral Out shall be connected together internally and shall have an MOV similar solid state device or gas discharge tubes rated at 20 KA between Main Neutral and Ground terminals.
j) Peak clamp voltage: 350 Volts at 20 KA (Voltage measured between Equipment Line Out and Equipment Neutral Out terminals. Current applied between Main Line and Ground Terminals with Ground and Main Neutral terminals externally tied together.). Voltage shall never exceed 350 volts.
k) The Protector shall be epoxy encapsulated in a flame retardant material.
l) Continuous service current, 10 Amps at 120 VAC RMS.
m) The Equipment Line Out shall provide power to the Type 170 and to the 24 V power supply.
n) Provide communications line protector with a mounting connector for incoming and outgoing communication line.

k. (Add the following Article) Cabinets shall be furnished with all necessary auxiliary control equipment to properly operate twelve signal phases and six pedestrian phases, which includes conflict monitor unit, isolation modules, detector sensing units as specified on contract documents, and load switch packs.
l. (Add the following Article) Cabinets shall include 14 inch aluminum riser.
m. (Add the following Article) Each cabinet shall include LED lighting fixtures mounted inside the front and back portion of the cabinet. These fixtures shall include a protective cover and shall operate by a normal power UL listed ballast. Two door actuated switches shall be installed to turn on the cabinet light when the door is open, front door front light back door back light. Each switch should work each individual light.

3. Auxiliary Equipment: (Replace the following Article) Contractor shall provide/install/integrate conflict monitor/malfunction management unit, flasher, load switches, terminals and facilities, and miscellaneous equipment and materials as necessary to provide for a complete and operational traffic signal system. Specific notes include:

a. Loop Detector Amplifier: All loop detector amplifier units furnished for this project shall be Model 222, Two-Channel Loop Detector Sensor Units with audible feature meeting the following requirements:
1) Digital design capable of normal operation when operated with a grounded loop.
2) Shall comply with all performance requirements when connected to an inductance from 50 to 1500 microhenries.
3) Each detector channel shall respond to an absolute inductance change (Delta L) rather than as a percentage of the total inductance (Delta L/L).
4) Unit must have optically isolated outputs.
b. Switch Pack: Each vehicular and each pedestrian phase shall be provided with a separate switch pack.
c. Isolator: A Model 242 Two-Channel Isolator shall be provided to introduce stop timing to the controller from the conflict monitor and the manual flash switch.
d. Conflict Monitor: The Model 2010ECLip (w/ Ethernet Port) Monitor Unit shall be provided. The conflict monitor provided shall have broad fault coverage, full intersection display, event logging and RMS voltage reporting. It shall include support for flashing yellow arrow operation. The monitor shall include an Ethernet port for communication with a personal computer or traffic management center. Downloadable information shall include monitor status, event logs, and fiver signal sequence history logs, which are stored in the monitor’s nonvolatile memory.
e. Power Supply: A "PDA-2" Power Distribution Assembly shall be provided.
f. Shelf: A standard print shelf drawer shall be provided and installed above the input file.

4. **Locate Boxes:** (Add the following Article) An outdoor-rated, single gang box to house communications / interconnect tracer wire shall be installed on the exterior of the controller cabinet. The location on the cabinet shall be determined by the project engineer. The locate box shall be constructed of die-cast aluminum with a die-cast zinc weatherproof cover and self-closing lid. The box shall be 2 3/4 inches by 4 1/2 inches by 2 5/8 inches D. A 12 inch long ground wire shall be attached to a lug within the box.

D. Ethernet Switch: (Add the following Article) Coordinate the installation of an Ethernet switch with the City Traffic Signal Shop.

1. The City shall provide the following:
   - **a.** Configured Ethernet Switch
   - **b.** Small Form Factor Pluggables (SFPs)

2. The Contractor shall provide the following:
   - **a.** Jumpers
   - **b.** All other equipment necessary to install and integrate Ethernet switch into the traffic signal cabinet.

4189.05 POLES, HEADS, AND SIGNS.

A. Vehicle Traffic Signal Head Assembly. (Replace the following Articles)

1. **Housing:** Each section shall be complete with a one-piece, hinged door with watertight gaskets and two stainless steel locking devices. All screws, latching bolts, and hinge pins shall be stainless steel to prohibit rust and corrosion. All sections of the vehicle signal head housings shall be of the black in color including the visor and door. The black color shall be permanently molded into the components.

7. **Mounting Hardware.**
   - **b. Universally Adjustable:** The traffic signal mounting bracket shall be universally adjustable. Rigid mounted, consisting of both top and bottom brackets and easily adjustable in both horizontal and vertical planes. The mounting assembly shall be of a cable type.

B. Pedestrian Traffic Signal Head Assembly. (Replace the following Article)

1. **Housing:**
   - **a.** All pedestrian signal heads shall be light emitting diode (LED).
   - **b.** The signal head shall be designed so that all components are readily accessible from the front by opening the signal door.
   - **c.** The housing shall be one piece, 16 inch by 16 inch (nominal) in size. The housing case shall include four integrally- cast, hinged lug pairs; two at the top and two at the bottom of each case. The case, when properly mated to other pedestrian signal components and mounting hardware, shall provide a dustproof and weatherproof enclosure and shall provide for easy access to and replacement of all components.
   - **d.** The door frame shall be one piece, complete with two hinged lugs cast at the bottom and two latch slots cast at the top of each door. The door shall be attached to the case by means of two, type 304 stainless steel spring pins.
   - **e.** All screws, latching bolts, and hinge pins shall be stainless steel to prohibit rust and corrosion.
   - **f.** The countdown pedestrian indicator unit shall fit in a traditional 16 inch by 16 inch pedestrian signal head housing.
   - **g.** All pedestrian signal heads shall be mounted using a clamshell-style mounting bracket.

C. Traffic Signal Poles and Mast Arms.

1. General.

b. (Replace the following Article) Ensure the mast arms, poles, and supporting bases are galvanized on both interior and exterior surfaces according to ASTM A 123, or as specified on the plans, and per Article 4189.05, C, 5.

j. (Add the following Article) All mast-arms shall have a 4% rise when in-place and fully loaded.

k. (Add the following Article) Mast arms shall be continuous to 50 feet in length. Vertical pole configuration shall provide for two-piece combination pole with internal tapped plate connection to allow for addition or removal of luminaire pole extension. Poles shall be vertical under normal load.

2. Pole Design: (Add the following to the existing Article) The Contractor shall provide designs for all concrete bases where mast arms are longer than 70 feet or when it is called for on the plans. The cost for the design shall be considered as part of the cost of the mast arm pole. This design would then be used as a substitute for footing design as shown on the signal detail sheet of the plans. The use of the ground rod and the number of conduits as indicated on the signal detail sheet of the plans shall remain the same.

5. Pole Finish: (Add the following Article) This section specifies requirements for certain items on the project; including signal poles, signal pole mast arms, light poles, light pole mast arms, and luminaires, as specified on the plans.

a. Quality Control: The galvanizing, wet paint process, powder coating, and/or finish painting facilities shall be owned and operated by the pole manufacturer to ensure a quality coating system.

b. Packaging: Prior to shipment, small poles shall be wrapped in 0.188 inch thick Ultraviolet-inhibiting plastic backed foam. Larger poles shall be cradled in a 1.0 inch rubberized foam base.

c. Field Repair Procedures: Where factory applied finishes/coatings have become damaged or abraded due to handling, transport, installation, welding or other circumstances, they shall be repaired by the field painting crew or miscellaneous metal contractor. All damaged areas shall be thoroughly wire brushed. All dirt, oil, grease, or other contaminants shall be removed in accordance with SSPC-SP1 and SP5. Touch-up paint supplied by the galvanizer or steel fabricator, identical in color and composition to that used in the plant, shall be applied to all prepared surfaces to a dry film thickness of at least 4.0 mils.

D. Traffic Signal Pedestal Poles. (Replace the following Article)

1. Materials.

c. Pedestal Base:

2) Base: Minimum weight of 20 pounds with a four bolt pattern uniformly spaced on a 13 3/4 inch diameter bolt circle. Meet or exceed AASHTO breakaway requirements.

E. Traffic Signs:

2. Sign Mounting Brackets: (Replace the following Article) All signs shall be supplied with a sign bracket. The traffic sign bracket shall be an articulated serrated bracket assembly that includes top, middle, and bottom sign mounting brackets and provides a rigid-mount for the traffic sign. All necessary hardware for a complete installation on a mast arm shall be included. The mounting assembly shall be of a cable type. Approval of other bracket supports shall be based on specifications and/or test data about their physical properties and performance properties.

All pedestrian pushbutton signs shall be mounted to the signal pole using stainless steel bolts. Bolts shall be 5/16 inch flanged with plastic washer. Holes shall be drilled and tapped.

4. **Traffic Sign Blanks:** (Add the following Article) All sign blanks shall be aluminum allow 6061-T6 conversion coated with Alodine 1200. 5052-H38 alloy is an acceptable alternative.
   - **a.** All blanks shall be 0.08 inches thick will the following exceptions:
     - **1)** If either the length or width dimension of a sign is 36 inches or greater, the blank shall be 0.125 inches thick.
     - **2)** Overhead mounted street name signs shall be 0.125 inches thick.
   - **b.** Blanks shall be finished free of any surface or edge burrs, cut marks, or other irregularities.
   - **c.** Standard signs shall be pre-drilled with standard hardware holes (0.375 inch diameter) and have no burrs or excess material retained in or around the hole. Holes placement and radii shall conform to the Standard Highway Signs Manual, current edition.
   - **d.** A diagram showing the location of holes for specialty signs will be provided at the time of order.
   - **e.** Street name signs shall not be pre-drilled.

5. **Traffic Sign Faces:** (Add the following Article) The background sheeting used on all signs, with the exception of pedestrian pushbutton signs, shall be 3M DG3 material. Any other applied material, including legends, letters, numbers, or borders, again with the exception of pedestrian pushbutton signs, shall also be 3M DG3 material. Pedestrian pushbutton signs shall be 3M Engineer Grade Prismatic reflective sheeting.

   This material shall have a standard warranty to be free from any defects for a period of not less than 7 years from the date of manufacture. A copy of the standard warranty shall be provided as a part of the bid package.

6. **Street Name Signs.** (Add the following Article)
   - **a.** All street name signs shall be single-sided.
   - **b.** The length of the street name sign shall be in 6 inch increments and will vary based on the legend.
   - **c.** Lettering shall be white and the background shall be blue or green “EC” film. The background color will be specified at the time of order.
   - **d.** Lettering shall be Series B as outlined in the Standard Highway Signs Manual.
   - **e.** All 12 inch or larger signs shall have a white border as shown in the attached detail.
   - **f.** Letter size and spacing shall conform to the MUTCD and the attached details. In cases where descending lower-case letters (g, j, p, q, and y) cannot be accommodated on the specified blank, the next larger blank size shall be used.
   - **g.** Twelve inch or larger street name signs shall be made of 3M Diamond Grade DG3 reflective sheeting. Eight inch street name signs shall be made of 3M High Intensity Prismatic reflective sheeting.

7. **Completed Signs:** (Add the following Article) Sign faces shall be firmly attached to the aluminum sign blanks, with no air bubbles, wrinkles, creases, tears or other surface blemishes. The faces shall be neatly trimmed to match the edge of the sign blank. The sign faces shall be properly positioned to provide a uniform border around all sides of the sign.

   The signs shall be handled carefully and packaged to prevent any damage to the sign faces. Any sign faces which are damaged at the time of delivery will be rejected and returned to the manufacturer. Undamaged replacement signs shall then be promptly sent, at no extra cost to the City of Des Moines.

4189.06 STREETLIGHTING. (Add the following Articles)

A. Luminaires: When specified for on the plans, Contractor shall supply and install luminaires and the luminaires shall be Autobahn Series wattage equivalent as shown in the plans.

1. 100 watt equivalent = ATB0 20BLEDE53 MVOLT R2

2. 150 watt equivalent = ATB0 20BLEDE10 MVOLT R2

3. 250 watt equivalent = ATB2 40BLEDE10 MVOLT R2

B. Disconnect: Contractor shall provide and install a disconnect breaker in the signal cabinet for the streetlighting. The disconnect shall be a QOU120 or approved equal.

Attachment A:
(Can be made available in Excel form to Awarded Contractor)

Traffic Signal Installation - Supplemental Unit Cost Form
Intelligent Transportation System - Phase Four - Des Moines, IA

No.	Item Description	SITE ID # Units	Total Quantity QTY	Unit Price	Unit Extension
1	Handhole, Type 1, 24" Round (MetroNet Shared)	EA	4	$	$
2	Handhole, Type 1, 24" Round (in sidewalk)	EA	1	$	$
3	Handhole, Type 1, 24" Round (in sidewalk) (MetroNet Shared)	EA	2	$	$
4	Handhole, Type 3 "Tub" 24" x 36" Stackable (MetroNet Shared)	EA	1	$	$
5	Handhole, Type 4 "Tub" 30" x 48" Stackable	EA	1	$	$
6	Handhole, Type 4 "Tub" 30" x 48" Stackable (MetroNet Shared)	EA	1	$	$
7	Conduit - 2" PVC Pushed	LF	115	$	$
8	Cable - Tracer 1c #10	LF	39,785	$	$
9	Pull Rope	LF	39,785	$	$
10	Removal of Existing 12 Strand Multi-Mode Fiber Optic Cable (within Existing Conduit)	LF	35,650	$	$
11	Removal of Existing 12 Strand Multi-Mode Fiber Optic Cable (within Existing Bridge Conduit)	LF	510	$	$
12	Removal of Existing Hybrid Fiber Optic Cable (within Existing Conduit)	LF	360	$	$
13	Removal of Existing Twisted Wired Paired Cabling (within Existing Conduit)	LF	20	$	$
14	Installation of 12 Strand Single-Mode Fiber Optic Cable (within Existing Conduit)	LF	5,960	$	$
15	Installation of 48 Strand Single-Mode Fiber Optic Cable (within Existing Conduit)	LF	43,970	$	$
16	Installation of 48 Strand Single-Mode Fiber Optic Cable (within Existing Bridge Conduit)	LF	710	$	$
17	Installation of 12 Strand Single-Mode Fiber Optic Cable (within New Conduit)	LF	0	$	$
18	Installation of 48 Strand Single-Mode Fiber Optic Cable (within New Conduit)	LF	315	$	$
19	2070 ATC Controller and Accessories - Complete Replacement	EA	39	$	$
20	Install City Supplied Ethernet Switch w/ City Supplied SFPs - Complete Installation	EA	39	$	$
21	Uninterruptible Power Supply/Battery Back-Up System - Complete System Installation	EA	9	$	$
22	PTZ Traffic Monitoring Camera System - Complete System Installation	EA	8	$	$
23	Remove/Salvage Existing PortServer Device for SM to MM Conversion	EA	11	$	$
24	Remove/Salvage Existing Fiber Optic Line Transceiver for SM to MM Conversion	EA	11	$	$
25	Handhole Contained Fiber Optic Splice Enclosure - Complete Installation	EA	38	$	$
26	Fiber Optic 24 Splice Tray	EA	46	$	$
27	Fiber Optic 36 Splice Tray	EA	1	$	$
28	Fiber Optic Splice (With Protector Sleeve)	EA	754	$	$
29	UPC/LC Factory Terminated Fiber Connector and Pigtails (Include Splice and Protector Sleeve)	EA	468	$	$
30	6 Duplex LC Connector Adapter Panel	EA	38	$	$
31	Splice Cassette	EA	38	$	$
32	Housing Adapter Bracket	EA	36	$	$
33	Single Panel Housing (Holds 1 Panel with Splice Organizer)	EA	3	$	$
34	Controller Integration Support into City's Existing ATMS Software	LS	1	$	$
35	Fiber Optic Acceptance Testing	LS	1	$	$

Total Lump Sum to Furnish and Install Traffic Signals $

Approved:
City Traffic Engineer Date