SP-127002
(NEW)

Iowa Department of Transportation

SPECIAL PROVISIONS
FOR
TRAFFIC SIGNAL INTERCONNECT

Polk County
STP-A-3827(613)--86-77

Effective Date
December 18, 2012

THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

INDEX

1. GENERAL

1.1 This part of the specifications includes the furnishing of all material and equipment necessary to complete, in place and operational, a traffic signal interconnect fiber optic system and traffic data center as described in the project plans.

1.2 The Standard Specifications for Highway and Bridge Construction, Series 2012, as modified by these specifications or other appropriate special provisions shall apply to this project. The installation of the traffic control signals and appurtenances shall be in conformance with the Manual on Uniform Traffic Control Devices, latest edition.

1.3 The Contractor shall be responsible for ONE-CALL locates of the fiber cables installed under this project until acceptance of the project by the City.

1.4 At the completion of the project, the Contractor shall provide the city with as-built drawings of the fiber optic system.

1.5 At the completion of the project, the Contractor shall mark the vertical and horizontal location of all conduits with paint and flags. The Engineer will use their GPS equipment to map the conduit, footing, and handhole locations.

1.6 Wiring Diagrams – Fiber optic wiring diagrams are provided to define the electrical wiring of all traffic cabinets, hubs, and facilities. Discrepancies between any wiring diagrams shall be resolved with the Engineer prior to installation. Changes to the wiring diagrams may occur during the project based on user demand and future projects interacting with this project. The Contractor shall maintain accurate quantities of splices and terminations at each location during the project. Wiring diagrams shall be red-lined as part of the “normal As-Built” records provided to the Engineer.

2. SYSTEM INTEGRATOR

2.1 The Contractor shall provide a Communications Coordinator/System Integrator to facilitate with system integration and fiber optic cable certification. The Communications Coordinator shall have experience in the preparation of cabinet fiber termination drawings, the installation of fiber systems communications equipment, and fiber optic cable testing procedures.

2.2 The Communications Coordinator/System Integrator shall install, program, network, connect, and test the complete traffic signal system including all communications, switches, the traffic management software, the PTZ cameras, and any other component of the complete and functional system.

2.3 The Communications Coordinator/System Integrator shall supply an IP address schema. The IP address schema will include a plan for all devices on the network, both supplied by this contract and devices supplied by future contractors. The address inventory shall be provided electronically to the City at project completion.

2.4 The Communications Coordinator system integration, installation certification, and fiber optic cable certification shall be considered incidental to the contract lump sum price for the Fiber Optic System.

3. EQUIPMENT AND MATERIALS

3.1 Fabrication or assembly process materials shall comply with the applicable parts of Section 2523 of the Standard Specifications with the additions as stated herein.

3.2 Equipment and materials shall be of new stock unless the plans provide for the relocation of or the use of fixtures furnished by others. New equipment and materials shall be the product of reputable manufacturers of electrical equipment, and shall meet Engineer approval.

3.3 A PDF file of catalog cuts and manufacturer's specifications shall be furnished for all standard "off-the-shelf" items.

3.4 Engineers review of shop drawings and catalog cuts shall not relieve the Contractor of any responsibility under the Contract documents.

3.5 All electrical equipment shall conform to the standards of the National Electrical Manufacturers Association (NEMA), and all material and work shall conform to the requirements of the National Electrical Code (NEC), the Standards of the American Society for Testing Materials (ASTM), the American Standards Association (ASA), and local ordinances. Miscellaneous electrical equipment and materials shall be UL approved.

3.6 Wherever reference is made in these specifications or in the standard provisions to the code, the safety orders, the general order, or the standards mentioned above, the reference shall be construed to mean the code, order, or standard that is in effect at the date of advertising of these

Specifications.

3.7 Certification from the manufacturers of all electrical equipment, conduit, and cable shall be supplied by the Contractor stating said materials comply with these Specifications.

3.8 Any existing equipment designated to be removed on the project shall remain the property of the City of Johnston. The Contractor shall deliver any removed equipment to the City of Johnston Public Works Facility, 6400 Beaver Drive.

4. TESTING AND MAINTENANCE OF SIGNAL EQUIPMENT

4.1 Notify the Engineer the date the signal or signal system will be ready for testing once the project is open to traffic.

4.2 Upon authorization of the Engineer, place the signal or signal system in operation for a consecutive 30 day test period. The signal(s) shall not be placed into operation without prior notification and authorization of the Engineer. Any failure or malfunction of the equipment furnished by the Contractor, exclusive of minor malfunctions (such as lamp burnouts) occurring during the test period, shall be corrected at the Contractor's expense and the signal or system tested for an additional 30 consecutive day period. This procedure shall be repeated until the signal equipment has operated satisfactorily for 30 consecutive days.

4.3 A representative from the manufacturer and/or supplier of signal controller shall be at the project site when the signal controllers are ready to be turned on, to provide technical assistance including, as a minimum, programming of all necessary input data. All required signal timing data shall be provided by the Engineer.

4.4 After signal turn on and prior to final acceptance of the completed traffic signal system, the Contractor shall respond, within 24 hours, to perform maintenance or repair of any failure or malfunction reported.

5. GUARANTEE

5.1 In addition to warranties or guarantees on specific system equipment listed elsewhere in these specifications, the Contractor shall fully guarantee the equipment installation furnished as part of the contract against defective equipment, materials, and workmanship for 12 months. Should any defect develop under normal and proper operating conditions within these specified periods after acceptance of the completed installation by the Owner, this malfunction shall be corrected by, and at the expense of the Contractor, including all labor, materials, and associated costs.

5.2 This guarantee shall be provided in writing on Company or Corporation letterhead stationary by the contractor to the owner prior to final acceptance.

5.3 The Contractor shall transfer all required equipment warranties on the date of final acceptance to the Owner.

6. HANDHOLES

6.1 Handholes shall be installed at the locations shown on the plans, and at such additional points, as the Contractor, at his own expense, may desire to facilitate the work.

6.2 Furnish pre-cast concrete handhole or poured in-place concrete handhole, each with a cast iron ring and cover.

6.3 The body of the precast hand hole shall meet the requirements for Class 1500D concrete pipe insofar as applicable.

6.4 Cast iron ring and cover (Neenah R-5900E) may be rated light duty for non-traffic areas (145 pounds minimum); but shall be rated heavy duty for traffic areas (320 pounds minimum) where shown on the plans. Deviations in weights shall not exceed ± 5%.

6.5 The cover shall have the words FIBER OPTIC cast on the top of the cover.

6.6 Cable hooks - Four cable hooks shall be provided in all handholes as detailed on the plans. Cable hooks shall be galvanized steel with a minimum diameter of 3/8 inch and a minimum length of 5 inches and anchored in the wall of the hand hole utilizing appropriate anchoring devices.

6.7 Handholes shall be installed in a neat and workmanlike manner. When the use of forms is required they shall be set level and of sufficient thickness to prevent warping or other deflections from the specified pattern. A means shall be provided for holding conduit runs rigidly in place while the concrete is placed. All conduits shall enter the handhole at the middle of the handhole. Any deviations from this requirement shall be approved by the Engineer. The ends of all conduit leading into the handhole shall fit approximately 2 inches beyond the inside wall. A coarse aggregate drain of 1 inch clean stone or gravel conforming to the dimensions shown on the plan details shall be provided. Cast iron rings and covers for handholes shall be set flush with the sidewalk, pavement, or the surface of the ground.

6.8 Precast polymer concrete handholes shall be stackable, have bolted covers, and be sized 30 inches by 48 inches (Type 3) with minimum depth 30 inches, unless otherwise specified in the Plans. The polymer concrete material shall meet or exceed all appropriate ANSI/ SCTE 77 tests and requirements. The bottom shall be “open” unless otherwise specified in the Plans. The lid shall be imprinted with the legend “FIBER”, as shown on the Plans, and satisfy loading requirements of ANSI Tier 15. A minimum of four cable hooks will be installed in each junction box to support cables.

7. CONDUIT SYSTEM

7.1 The number, type, and size of conduit shall be as shown on the plans. Conduit shall meet the requirements of Articles 2523.03, N and 4185.10 of the Standard Specifications.

7.2 Conduit shown on the plans as rigid steel shall be galvanized steel meeting the requirements of

ANSI Standard Specification C80.1, latest revision.

7.3 Conduit shown on the plans as polyvinyl chloride (PVC) conduit shall meet the requirements of NEMA TC-2, Type 2, and applicable UL Standards. HDPE conduit, orange in color, with a SDR of 13.5 will be allowed to be used in place of PVC conduit.

7.4 Conduit shall be placed as shown on the plans. Change in direction of conduit shall be accomplished by bending such that the conduit will not be injured or its internal diameter changed. Bends shall be of uniform curvature and the inside radius of curvature of any bend shall not be less than six times the internal diameter of the conduit.

7.5 When it is necessary to cut and thread steel conduit, no exposed threads will be permitted. All couplings shall be tightened until the ends of conduits are brought together so that an electrical connection will be made throughout the entire length of the conduit run. All conduit and fittings shall be free from burrs and rough places and all conduit runs shall be cleaned, swabbed, and reamed before cables are installed. Nipples shall be used to eliminate cutting and threading where short lengths of conduit are required. Damaged galvanized finish on conduit shall be painted with zinc rich paint. All fittings used with rigid steel conduit shall be galvanized steel only.

7.6 Approved conduit bushings shall be installed on the exposed ends of rigid steel conduit. Bell end fittings shall be installed on the exposed ends of P.V.C. or HDPE conduit. In all bases, conduit shall extend a minimum of 4 inches above the finished surface.

7.7 Conduit buried in open trenches shall be placed a minimum of 42 inches deep unless otherwise directed by the Engineer or on the plans. 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. All conduits shall be placed at a depth between 42 inches and 48 inches. The contractor shall maintain depth control on the placement of conduit. Use of directional boring equipment is highly recommended.

7.8 The backfill material in open trenches shall be deposited in layers not to exceed 6 inches in depth and each layer shall be thoroughly compacted before the next layer is placed. Backfill material shall be free of cinders, broken concrete, or other hard or abrasive materials. All surplus material shall be removed from the public right-of-way.

7.9 Whenever excavation is made across parkways, driveways or sodded areas, the sod, topsoil, crushed stone or gravel shall be replaced or restored as nearly as possible to its original condition and the whole area involved shall be left in a neat and presentable condition. Concrete sidewalks, pavements, base courses, and bituminous surfaces shall be replaced with new materials. Surface restoration shall be completed in accordance with the current edition of "Statewide Urban Design and Specifications for Public Improvements" and shall be considered incidental to the bid items of the project and will not be paid for separately.

7.10 "Pushed" conduit shall be placed by jacking, pushing, boring, or any other means necessary to

place the conduit without cutting, removing, or disturbing existing pavement. The size of a bored hole shall not exceed the outside diameter of the conduit that is to be placed. Tunneling under the pavement or water jetting will not be permitted. Pits for boring shall not be closer than two feet to the back of curb unless otherwise directed by the Engineer.

7.11 All conduit openings in the hub cabinet, handholes, bases, and buildings shall be sealed with an approved sealing compound. This compound shall be readily workable soft plastic. It shall be workable at temperatures as low as 30°F, and shall not melt or run at temperatures as high as 300°F.

8. WIRING

8.1 Slack for each cable shall be provided by a 10 foot length in each hand hole. Coil cable slack in hand hole and place on the hooks.

8.2 Cables shall be pulled through conduit by means of a cable grip designed to provide a firm hold upon the exterior covering of the cable or cables, with a minimum of dragging on the ground or pavement. This shall be accomplished by means of reels mounted on jacks, frame mounted pulleys, or other suitable devices. Only vegetable lubricants may be used to facilitate the pulling of cable.

9. ELECTRICAL CABLE

9.1 General

9.1.1 Electrical cable for intersection signalization shall be rated 600 volts minimum.

9.1.2 The number of conductors and size of all electrical cable shall be as shown on the plans.

9.1.3 All wire shall be plainly marked on the outside of the sheath with the manufacturer's name and identification of the type of the cable.

9.2 Power Lead-In Cable

9.2.1 Power lead-in cable shall be 600 volt, single conductor, stranded copper, Type USE, with UL approval and size as shown on plans.

9.3 Tracer Wire

9.3.1 A tracer wire shall be installed in all conduits.

9.3.2 The tracer wire shall be a #10 AWG, single conductor, stranded copper, Type THHN, with UL approval and an orange colored jacket.

9.3.3 The tracer wire shall be spliced in the hand holes and controller to form a continuous

network. The splice shall be a soldered connection and then covered with a wire nut.

9.4 Pull Rope

9.4.1 A pull rope shall be installed in all conduits.

10. REPLACING DAMAGED IMPROVEMENTS

10.1 Improvements such as sidewalks, curbs, driveways, roadway pavement and any other improvements removed, broken, or damaged by the Contractor shall be replaced or reconstructed with the same kind of materials found on the work or with materials of equal quality. The new work shall be left in serviceable condition satisfactory to the Engineer. Whenever a part of a square or slab of existing concrete sidewalk, driveway, or pavement is broken or damaged, the entire square or slab shall be removed and the concrete reconstructed.

11. TRAFFIC SIGNAL (ACTUATED) CONTROLLER

11.1 General

11.1.1 The local intersection controller shall be a Siemens M52 Series controller unit manufactured by Siemens, so as to be fully compatible and interchangeable with existing local controllers in the City of Johnston, support the TACTICS signal system, and support all features of the system including communication over 10/100 BASE-T Ethernet and single mode fiber optic cable. One controller shall be supplied at each cabinet. The controller will operate the intersection signals. Each controller shall be NTCIP compliant. The Engineer may specify alternate or additional communication capabilities as needed.

11.1.2 The controller to be provided shall provide two through eight phase operation. The controller unit shall be provided with the NEMA defined “A”, “B”, “C”, and manufacturer specific “D” connectors, an RS-232 Serial Port that allows controller unit programming without referencing the controller unit system address, an RS-232 Serial Port that allows controller unit programming requiring reference to the controller unit system address, an SDLC Serial Port as defined by NEMA TS-2 and a communications port that is designed for fiber optic interconnect.

11.1.3 The controller shall provide fully prompted, menu driven programmability.

11.1.4 The controller shall provide the following internal functions:

Software compatible to the control and data protocol of the central office traffic signal system software and computer.

Provision of a local time base scheduler including automatic accommodation for day light savings time.

Provision for local coordination control.

Provision for local preemption control with at least six programmable internal preemption sequences.

Provide data uploading and down loading capability.

Process system and local intersection detector activity and accumulate samples of vehicle count, occupancy, and speed.

Provide local control of remotely selected NEMA and special functions.

Ability to handle up to eighty detectors. Detectors shall include the ability to have a single detector input be assigned to phase extension, system volume and occupancy, and lane count concurrently. Lane count shall include as a minimum twenty-four isolated detector assignments for the purpose of accumulating 15 minute volume counts for each detector. Controller memory shall allow accumulation of a minimum of sixteen hours of data, 15 minute counts for twenty-four detectors, before requiring data uploads to the central computer.

Perform local report generation with printer capability, including intersection status and performance.

Provide the capability to communicate by means of hard-wire, fiber optic or radio interconnects. The controller shall be capable of operating in each type of system without additional modifications, other than installation of the appropriate modem and interface.

11.1.5 The controller shall be microprocessor type, modular, solid state providing the phasing and operation as shown on the plans. The controller shall be designed for use on nominal 120 volt, 60 Hz, single- phase alternating current.

11.1.6 The controller unit shall utilize digital timing concepts for interval settings for all phases and shall contain vehicular and pedestrian circuits and timing functions for all phases.

11.1.7 The controller equipment furnished shall be new, of the latest model, fabricated in a first-class workmanlike manner from good quality material. The manufacturer shall replace free of charge to the Contractor and/or Owner any part that fails in any manner by reason of defective material or workmanship within a period of 12 months from the date that the equipment was placed into operation following installation.

11.2 Components

11.2.1 The controller unit shall use modern integrated circuits and computer technology to the fullest extent feasible and incorporate digital timing techniques.

11.2.2 All component parts and terminals shall be readily accessible when the controller modules are removed from the enclosure for adjustments, testing or service.

11.2.3 The controller unit shall be designed so that the length of interval, portion, period or unit extension shall not deviate by more than plus or minus 100 milliseconds from its set value at a power source frequency of 60 Hz.

11.3 Chassis

11.3.1 The controller unit shall be modular in design. Modules or function boards shall be removable and inserted without the use of any tools. Modules of unlike function shall be mechanically keyed or electrically inter-locked to prevent insertion into the wrong opening. All modules of the same function shall be interchangeable.

11.3.2 The front panel of the unit shall be permanently marked to identify the fuses, indicators, switches, controls, etc. so that the operation of the controller shall be readily apparent. The option card slot panel section shall be provided with two each panels. The two panels shall allow insertion of one or more card devices and maintain a closed front chassis assembly.

11.3.3 The control devices, indicators, fuse holders, switches, input/output connectors, and other components required for the operation and adjustment of the timer shall be mounted on the front panel.

11.3.4 Certification of a manufacturer's controller assembly by an independent testing laboratory shall be provided to the Engineer. This certification shall indicate that the manufacturer's controller assembly is in accordance with the test procedures as specified in the NEMA Standard No. TS1-1983. Certification to NEMA Standard No. TS-2, current edition at the time of bid shall be acceptable.

11.3.5 All components shall be amply de-rated with regard to heat dissipating capacity and rated voltage so that, with maximum ambient temperatures and maximum applied voltage, a material shortening of life or shift in values shall not occur.

11.3.6 The design life of all components under 24 hours a day operating conditions in their circuit applications shall be not less than 5 years.

11.3.7 Controller timing shall be set by means of a front-panel keyboard. Momentary contact push buttons shall be used for entering numeric data.

11.4 Interval Programming

11.4.1 The controller unit shall provide for setting of the timing of each interval or period by means of keyboard.

11.4.2 The controller unit shall utilize fully prompted, menu programmability to input controller data.

11.4.3 The keyboard shall be on the front panel of the unit. They shall be easily identifiable and it shall not be necessary to remove or change wires or contacts or to use any tools in making interval adjustments.

11.4.4 Each phase shall have identical control parameters that may be independently set for each phase.

11.4.5 The controller unit shall be capable of providing functions with the minimum timing ranges and timing increments as defined in NEMA Standards TS-2.16.4.6

11.4.6 Indications shall be provided and appropriately labeled to facilitate the determination of the operation of the controller unit. These indications shall consist of the following, as a minimum:

Phase or phases in service.
Phase or phases next to be serviced.
Presence of vehicle call, including memory and detector actuations.
Presence of a pedestrian call.
Ring status indicators, including the following: Minimum Green; Passage; Yellow Clearance; Red Clearance; Walk; Pedestrian Clearance; Reason for Termination; and Rest State.

11.4.7 The controller unit shall be capable of programming each phase to operate in the following modes through the keyboard push button switches or separate function switches.

Nonlocking vehicle detector memory
Locking vehicle detector memory
Vehicle recall
Pedestrian recall
Recall to maximum green

11.4.8 All operator keyboard entered data shall be retained in a memory medium that does not require battery backup.

11.4.9 Means shall be provided to control the flashing of pedestrian signals during the pedestrian clearance interval(s), Yellow and All Red or Yellow interval only.

11.4.10 The signal phasing and interval sequence shall be as shown on the plans.

11.5 Operational Requirements

11.5.1 The controller shall provide multi-phase operation and shall be fully actuated with means for receiving actuation on all phases.

11.5.2 The controller shall permit a non-actuated mode of operation on any of the phases by assertion of the vehicle recall function of the desired phase.

11.5.3 The actuation of a vehicle detector during the extendible portion of an actuated traffic phase having the right-of-way shall cause the retention of right-of-way by the traffic phase for the set Passage Time from the end of the actuation but subject to the Maximum.

11.5.4 The actuation of any detector on a traffic phase not having the right-of-way shall cause the transfer of the right-of-way to that traffic phase at the next opportunity in the normal phase sequence.

11.5.5 The timing of the Maximum Green shall commence with one of the following:

With the first actuation or demand for right-of-way on a traffic phase not having the right-of-way.

At the beginning of the Green interval if an actuated or demand for right-of-way has been previously registered on a traffic phase not having right-of-way.
In the absence of detector actuations or assertion of recall switches, the right-of-way indications shall remain on the traffic phase on which the last actuation occurred.

11.5.6 The transfer of right-of-way to conflicting phases shall occur only after the display of the appropriate change clearance intervals.

An actuation received during a change clearance interval for a traffic phase shall cause the right-of-way to return to that phase at the next opportunity in the normal phase sequence.

11.5.7 If the right-of-way is transferred by the operation of the Maximum or extension limit, the traffic phase losing the right-of-way shall again receive it without further actuation at the next opportunity in the normal phase sequence.

11.5.8 When pedestrian actuation is received a WALK interval shall be provided concurrently with the associated Green traffic phase interval. A flashing DON'T WALK Pedestrian Clearance interval shall follow the WALK interval during which the Green traffic phase continues to be displayed. A steady DON'T WALK shall follow the flashing DON'T WALK.

11.5.9 In absence of pedestrian actuation or the assertion of pedestrian recall function, pedestrian signals shall remain in a steady DON'T WALK condition.

11.5.10 Pedestrian actuations received by a phase during steady or flashing DON'T WALK indications of that phase shall be remembered and shall cause the controller to provide pedestrian timing functions for that phase at the next opportunity in the normal phase sequence. Successive pedestrian actuations shall not cause extension of pedestrian intervals.

11.5.11 During coordinated operation if phases are placed in a pedestrian recall mode of operation to operate the controller as a pretimed controller, the WALK intervals of the non-coordinated phases shall automatically adjust with changes in the timing plans to provide the maximum amount of WALK interval possible in the phase. The adjustment of the WALK interval for the non-coordinated phases shall be similar to the adjustment in the WALK interval for the coordinated phases with timing plan changes.

12. TRAFFIC SIGNAL SYSTEM CONTROL SOFTWARE & SERVERS (TACTICS)

12.1 The traffic signal system software shall be TACTICS Advanced Transportation Management System application manufactured by Siemens. The version of TACTICS shall be the Central office software system. This software shall control all traffic signal controllers in the field through a fiber connection to the TACTICS server. The software will be expandable to include other City traffic signal controllers brought into the system in the future.

12.2 The signal system software shall include installation, three user licenses, and training on the system.

12.3 Two years of annual product support for the system shall be included as incidental in the bid item.

12.4 The system integrator is responsible for a fully functional traffic signal system.

12.5 Included as incidental to the traffic signal system is the system hardware to run the software. Two servers will be supplied, installed, networked, and programmed.

12.5.1 TACTICS Central Server - Rack mount
Quad-core Intel Xeon processor at 2.4 GHz or above
4 GB RAM
24X CDROM or DVDROM
RAID 5 configuration with a minimum of four 160 GB Drives
Digi Portserver TS 8/16* (RJ45 16-port)
Dual 10/100/1000 Network Adapter
24 inch LCD Display
3 Year, 4 Hour Support Option
Microsoft Windows 2008 Server x86
Microsoft SQL Server 2008 Standard Edition
(* - Digi Portserver TS 8/16 to be used on servers with no PCI-X slots)

12.5.2 TACTICS Database Server - Rack mount
Quad-core Intel Xeon processor at 2.4 GHz or above

4 GB RAM
24X CDROM or DVDROM
Dual 10/100/1000 Network Adapter
Keyboard and mouse (or compatible pointing device)
RAID 5 configuration with a minimum of four 160 GB HDD Hotswappable
RD1000, Internal SATA Drive Bay with removable Media drives
Symantec Backup exec 12.x or greater with SQL Server Agent
3 Year, 4 Hour Support Option
Microsoft SQL Server 2008 Standard Edition
Use Display, keyboard, and mouse from other rack mounted server

13. FIBER OPTIC CABLE

13.1 All designed interconnect systems shall use single-mode fiber optic interconnect cable. All fiber optic components required to provide proper communication with the City traffic signal network shall be furnished and installed as part of this item. This work shall consist of furnishing and installing a fiber optic cable of the type, size, and number of fibers specified.

13.2 General Requirements

13.2.1 Materials and Equipment

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products. The fiber optic cable shall be Corning, OFS, or pre-approved equal and be manufactured utilizing Corning glass fiber conforming to the following specifications. All materials and equipment furnished shall be completely free from defects and poor workmanship. All fibers shall be glass and be manufactured by OFS, Corning or pre-approved equal. The cable shall be rated for gigabyte data bandwidth. All fiber shall be loose tube construction for both indoor and outdoor installation. Indoor cabling shall use plenum rated conduit to within less than 50 foot of point of termination eliminating the requirement to convert to indoor cable.

13.2.2 Contractor Qualifications

Trained and experienced personnel shall supervise the fiber optic cable installation. Qualified technicians shall make the cable terminations and splices. The Contractor upon request of the Engineer shall provide documentation of qualifications and experience for fiber optic equipment installations. The Engineer shall determine if the Contractor is qualified to perform this work. The Contractor shall have attended a certified fiber optic training class mandated by these specifications prior to starting work.

13.2.3 Codes Requirements

The fiber optic cable installation shall be in accordance with or exceed all minimal requirements of State codes, National codes, and manufacturer codes as applicable.

13.2.4 Miscellaneous Equipment

The Contractor shall furnish and install all necessary miscellaneous connectors and equipment to make a complete and operating installation in accordance with the plans, standard sheets, standard specifications, special provisions, and accepted good practice of the industry.

13.2.5 General Considerations

The cable shall meet all requirements stated within this specification. The cable shall be new, unused, and of current design and manufacture.

13.3 Fiber Characteristics

All fibers in the cable must be usable fibers and meet required specifications.

13.3.1 Single-Mode Fiber

Typical core diameter: 8.3um
Cladding diameter: 125 +1.0um by fiber end measurement
Core-to-cladding offset: <1.0um
Coating diameter: 250 +15um

Attenuation uniformity: No point discontinuity shall be greater than 0.1 dB, except terminations or patch cords, at either 1310nm or 1550nm. The coating shall be a layered UV cured acrylate applied by the fiber manufacturer. The coating shall be mechanically or chemically removable without damaging the fiber.

Factory cable rating shall be 0.35 dB/KM at 1310 nM and 0.25 dB/KM at 1550 nM. Installed tolerance shall be less than 0.44 dB/KM at 1310 nM and less than 0.33 dB/KM at 1550 nM, testing tolerance.

All fiber cables shall be Gigabyte rated, i.e. single mode shall be 28 KM for 1310 nM and 40 KM for 1550 nM based on a 10 dB power budget.

All Single mode fiber shall be rated for multi-frequency, four frequencies, equivalent to the AllWave OFS specification and shall be rated to withstand extended aging under water impregnation conditions.

13.4 Fiber Specification Parameters

13.4.1 All fibers in the cable shall meet the requirements of this specification. The testing tolerance attenuation specification shall be a maximum attenuation for each fiber over the entire operating temperature range of the cable when installed.

13.4.2 The change in attenuation at extreme operational temperatures for single-mode fibers shall not be greater than 0.20 dB/km at 1550 nm, with 80 percent of the measured values no greater than 0.10 dB/km at 1550 nm.

13.4.3 Optical fibers shall be placed inside a loose buffer tube, minimum six fibers per tube, normally twelve fibers per tube. Actual number of fibers per tube shall be twelve fibers per tube unless specified differently on the Plans.

Single-mode only – each buffer tube shall contain twelve or six fibers.

13.4.4 The buffer tubes will meet EIA/TIA-598, “Color coding of fiber optic cables.”

13.4.5 All fiber cables shall be Gigabyte rated, i.e. multimode shall be 200/500 Meter for 850 and 1300 nM respectively and 5000 Meter for 1310 and 1550 nM.

13.4.6 Single-mode fibers shall be placed in the first buffer tubes. Multimode fibers shall be in the remaining buffer tubes. Fiber count, tubes of fiber, shall be as specified on the plans.

13.4.7 Fillers shall be included in the cable core to lend symmetry to the cable cross-section where needed.

13.4.8 The central anti-buckling member shall consist of a glass reinforced plastic rod. The purpose of the central member is to prevent buckling of the cable.

13.4.9 The cable shall use a completely dry cable design without the use of gels and filling compounds. Dry water blocking material shall be used around the buffer tubes as well as internal to the tubes. Water blocking gels shall not be acceptable on this project.

13.4.10 Buffer tubes shall be stranded around a central member. Acceptable techniques include the use of the reverse oscillation, or “SZ”, stranding process.

13.4.11 All dielectric cables (with no armoring) shall be sheathed with medium density polyethylene. The minimum nominal jacket thickness shall be 0.05 inches. Jacketing material shall be applied directly over the tensile strength members and flooding compound. Cable jacketing shall utilize the newer designs to provide maximum flexibility without loss or appreciable dB attenuation. Cable diameter shall not exceed 0.50 inch.

13.4.12 The jacket or sheath shall be marked with the manufacturer’s name, the words “optical cable”, the year of manufacture, number of fibers, type of fiber (SM or MM) and sequential feet or meter marks. The markings shall be repeated every 3 feet. The actual length of the cable shall be within 0 + 1% of the length marking. The marking shall be in a contrasting color to the cable jacket. The height of the marking shall be approximately 0.10 inch. A copy of the manufacturer fiber definition and shipping sheet identifying all tests, results and fiber indexes shall be provided to the Engineer on delivery of cable to the City or shall be included with a contractor’s listing of place(s) of installation when installed by a Contractor.

13.4.13 The maximum pulling tension shall be 600 pounds during installation.

13.4.14 Wherever possible, six buffer tubes with twelve fibers each, or subsets specified, shall be

provided and designated as follows:

Buffer Tube/Fiber	Tube/Fiber Color
#1, 1st tube or fiber	blue
#2, 2nd tube or fiber	orange
#3, 3rd tube or fiber	green
#4, 4th tube or fiber	brown
#5, 5th tube or fiber	slate
#6, 6th tube or fiber	white
#7, 7th tube or fiber	red
#8, 8th tube or fiber	black
#9, 9th tube or fiber	yellow
#10, 10th tube or fiber	violet
#11, 11th tube or fiber	rose
#12, 12th tube or fiber	aqua

13.5 Quality Assurance Provisions

13.5.1 All optical fibers shall be proof tested by the fiber manufacturer at a minimum load of 100 kpsi.

13.5.2 All optical fibers shall be 100% attenuation tested at the manufacturer. The attenuation of each fiber shall be provided with each cable reel. The measured attenuation shall be for both 850 and 1300 frequency for multimode and 1310 or 1550 frequency for single mode. This documentation shall be provided with each spool. The Contractor shall designate on the Plans and on this (See 28.2.11) documentation the location where each spool has been installed and provide this data to the Engineer.

13.6 Cable Installed in Ducts and Conduits

13.6.1 A suitable cable feeder guide shall be used between the cable reel and the face of the duct and conduit to protect the cable and guide it into the duct off the reel. It shall be carefully inspected for jacket defects. If defects are noticed, the pulling operation shall be stopped immediately and the Engineer notified. Precautions shall be taken during installation to prevent the cable from being “kinked” or “crushed”. A pulling eye shall be attached to the cable and used to pull the cable through the duct and conduit system. A pulling swivel shall be used to eliminate twisting of the cable. As the cable is played off the reel into the cable feeder guide, it shall be sufficiently lubricated with a type of lubricant recommended by the cable manufacturer. Dynamometers or breakaway pulling swing shall be used to ensure that the pulling line tension does not exceed the installation tension value specified by the cable manufacturer. The mechanical stress placed on a cable during installation shall not be such that the cable is twisted or stretched. The pulling of cable shall be hand assisted at each controller cabinet. The cable shall not be crushed kinked or forced around a sharp corner. If a lubricant is used it shall be of water based type and approved by the cable manufacturer. Sufficient slack shall be left at each end of the cable to allow proper cable termination, MINIMUM OF 30 FEET. This slack

shall be in addition to installation slack as hereinafter specified. Additional slack cable shall be left in each hub cabinet, handhole, and at the top of each conduit riser. Excess slack at hub cabinets shall be re-pulled into the nearest handhole to provide a neat and orderly installation. The minimum slack amounts shall be as follows:

Hub cabinet – 50 feet
Type 1 Handhole – 30 feet
Type 2 Handhole – 30 feet
Type 3 Handhole – 100 feet

13.6.2 Storage of minimum slack cable in controller cabinets and additional slack at pull boxes shall be coiled. The slack coils shall be bound at a minimum of three points around the coil parameter and supported in their static storage positions. If stored in a manhole, fiber shall be stored along the outer most walls to allow unabated ingress and egress. The binding material and installation shall not bind or kink the cable. Storage of additional slack cable adjacent to conduit risers and support poles shall be as visibly marked/tagged as “CAUTION – FIBER OPTIC CABLE”. Maximum length of cable pulling tensions shall not exceed the cable manufacturer’s recommendations. Along with the fiber optic cable, one #10 AWG THHN, 600-volt single conductor cable (identifier conductor), orange in color, shall be pulled with 10 feet slack in each pull box. All fiber cables shall be marked with a metallic, or preapproved identifier in the handhole adjacent to the traffic signal cabinet or hub cabinet and on the cable in the hub cabinet at the point of termination. The identifier, both in the cabinet and in the handhole, shall indicate the direction the cable is going, cable contents [SM or SM/MM], and the abbreviated location for the other end destination.

13.7 Minimum Bend Radius

For static storage, the cable shall not be bent at any location to less than ten times the diameter of the cable outside diameter or as recommended by the manufacturer. During installation, the cable shall not be bent at any location to less than twenty times the diameter of the cable outside diameter or as recommended by the manufacturer.

13.8 After the Fiber Optic Cable Installation

13.8.1 Each section of the cable shall be tested for continuity and attenuation as a minimum. If the attenuation is found not to be within the acceptable nominal values, the Contractor shall use an optical time domain reflectometer (OTDR) to locate points of localized loss caused by bends or kinks. If this is not successful the Contractor shall replace the damaged section of cable with no additional payment. Splices will not be allowed to repair the damaged section. After all fiber cable is installed, all fibers, whether terminated or non-terminated, shall be tested with an OTDR. All fibers terminated shall be tested with a power meter. Each OTDR trace, for documented test result submittal, shall be displayed individually and not be combined with other fiber traces as overlays. Multimode fiber shall be tested using 1300 nm and single mode fiber shall be tested at 1310 nM. The results of the OTDR test shall be provided on an electronic media (disk)

and paper printout. The OTDR wave, pictorial diagram of dB loss over the length of fiber tested, shall be provided along with the measured data values. The printout shall contain the manufacturer's fiber optic Index of Refraction to the third decimal point for the fiber provided. The Contractor shall provide the Engineer with a written report showing all the values measured compared to the calculated values for length and coupler/connector losses at the completion of these tests.

13.8.2 Documentation provided to the Engineer shall include a written indication of every splice, termination, patch cord, etc. for cable being measured. Power meter measurement recordings shall indicate the exact measured distance [OTDR or field measurement with cross reference for oscillation multiplier] on the sheet showing the power meter readings. Any deviations between fiber readings in the same tube shall be notated for OTDR graphs as well as deviations greater than 5% on power meter readings. Rated values for acceptable installation shall be based on the following parameters:

Patch cords/Pigtails	.60 MM & .15 SM dB each
Unicam Terminations	1.0 dB set of 2 [In and Out]
Splices	0.08 each

1 KM = 0.3077 KF where KF is 1000 feet

13.8.3 Data documentation shall include for each test between buildings, the length of fiber as measured by OTDR, frequency used in test on OTDR by each fiber type, distance to each splice, termination or patch cord jumper, dB loss rating by manufacture from spool documentation, index of refraction by type of fiber in section, and the dB loss of each section as measured in the final test for each fiber. A special test shall be made on all continuous spliced fiber from start to end that includes the total dB loss measured and the OTDR plot on electronic disk. Splice points shall be identified on the trace.

13.9 Cable Termination

Terminations shall be made using the method recommended by the connector manufacturer. All fibers shall utilize a fan-out kit of the size and type recommended by the manufacturer and of the number of fibers provided in each fiber tube. All fibers terminated shall utilize a ceramic ferrule (outdoor connections), SC, mechanical termination equal to Siecor UniCam connectors, or be a wide temperature (-40° to +170° F) epoxy. Heat cured or epoxy type connections meeting the full temperature ratings are acceptable for this Project, including factory manufactured pigtails. The Contractor shall be required to provide proof of purchase of sufficient quantities of ceramic terminations for outdoor terminations to verify ceramic connector usage or temperature ratings on epoxy or heat cured processes prior to terminating any fibers. The Contractor may terminate fibers by splicing factory pigtails to the fiber ends and then connecting the pigtail to the fiber coupler in the fiber tray. When splicing pigtails to terminate, all splices shall be provided with the metal reinforced shrink tube protector. The contractor may terminate fibers by the use of UniCam mechanical termination connectors. All termination SC couplers shall be rated for dual fiber application, MM and SM.

13.10 Breakout Kits or Fiber Distribution Units

The breakout kits, fiber distribution units, or termination boxes used to terminate each fiber cable in the cabinet shall provide for the separation and protection of the individual fibers with the buffer tubing and jacketing materials. The termination housing shall be installed within a wall interconnect housing which shall provide for storing fibers, ample room for feed through cable, strain relief for multiple cables within unit, and accommodate SC compatible connectors. All fiber pigtails shall be terminated through SC connectors on the wall interconnect panel. All terminations shall be SC type, ceramic core (outdoor connections), and plug into the provided controller unit internal fiber optic modem. Acceptable enclosures for combination termination/splice points shall be MIC-024 or WDC-024 enclosures or pre-approved equal. Splices to pigtail fiber, where used, shall utilize fan out kit protection to the fiber, heat shrink tubing with metal bar reinforcement and 900 micron rated pigtail insulation. Splices to factory pigtails shall use pigtails that are rated for a minimum temperature range of 0°F to +150°F. In the absence of pigtails meeting this temperature rating, fibers shall utilize loose tube fiber in fanout kit tubes and UniCam mechanical SC connectors. These splices, fiber cable to pigtails, may be external to splice trays mounted internally to the enclosure, when shown on the wiring diagrams. All other splices, not specified to be installed external to the fiber splice tray, shall be installed in splice trays and be supported with heat shrink tubing. Acceptable splice trays include MIC-024-048 or 067 series or pre-approved equal.

13.11 Connectors

Connectors shall be mechanical SC (ceramic ferrule-outdoor connections) compatible, field installable, and self-aligning and centering or factory fabricated pigtails. Connectors to the special devices used for Ethernet network connections shall utilize a factory converter cable of SC to ST or manufacturer specified converter patch cord. Fiber optic equipment, used for terminating fibers, shall be rated for the type of connectors used. Connectors shall be Siecor CamLite, UniCam, or NEMA temperature rated epoxy type, or Engineer approved equal.

13.12 Splices

The fiber cable shall be installed in a continuous run between the southern most handhole of the project and the fiber hub cabinet at the corner of NW 62nd Ave and Merle Hay Road. No splices shall be allowed, unless shown on the plans. Only mechanical splices, Siecor CamLite, or approved equal will be allowed, when specified, such as testing of non-terminated fibers. Splices, where specified, shall be by fusion splice and shall be installed using an automatic fusion splicer. Splices between two fibers leaving the cabinet shall be supported in splice trays installed in splice enclosures. All splices shall be protected by heat shrink tubing designed for fiber optic splicing applications. Fibers being terminated in two separate termination or splice enclosures shall be supported between enclosures by the use of buffer tubing or approved equal support material or shall be pigtail patch cords. Termination / splice enclosures shall be separated by less than 12 inches unless a conduit is installed between enclosures. All splices shall be performed by an automated splicer device that verifies the final splice termination quality. All splices shall be nominally 0.03 to 0.05 dB loss but shall be less than a 0.08 dB loss.

13.13 Light Source

13.13.1 An LED light source with a wavelength that is the system wavelength, 850 and 1300 nm for multimode and 1310 and 1550 nm for single mode, shall be used. The LED shall be stable within 0.1 dB in intensity over a time period sufficiently long to perform the measurement. The output of the LED shall overfill the input end of the launch fiber/cable in both numerical apertures (NA) and core diameter. The accuracy of the combined light source and power meter shall be less than .05 dB and be temperature compensated stabilized to 0.01 dB over the operating range of the meter(s).

13.13.2 The Contractor shall provide one each Light Source and Power Meter and/or one each 650 nM visible light source, Model VF13 or approved equal, to the Fiber Optic Coordinator or City Technician complete with all attachments for measuring individual fibers of multimode at both 850 and 1300 nanometers and single mode at both 1310 and 1550 nanometers for spot testing/inspecting of installed and terminated fibers. This test kit shall include one each 200X power zoom scope for observing fiber ends for smoothness and fractures. AC power adapters shall be provided with all light and power meters as well as battery operation. This test kit shall remain the property of the Contractor. This test kit shall be made available from the beginning to completion of the project and be on-site at all times.

13.14 Power Meter

The detector in the power meter shall have an effective numerical aperture and active region that is larger than the receive reference cable and/or the fiber under test. The power meter shall have a minimum range from +3 DBMS to –40 DBMS. The power meter shall have an accuracy of +/- 0.5 dB through the operating temperature and minimum resolution of 0.1 dB.

13.15 Launch Reference Attenuator

13.15.1 The launch attenuator, two each for single and multimode fiber testing, shall be utilized for all OTDR tests such that one launch cable shall be at the beginning of the fiber being tested and the second launch cable shall be on the end of the fiber being tested past the final connector. Only one launch cable shall be required when testing non-terminated fiber. The launch attenuator(s) shall be of the same fiber core size and type as the fiber under test. The attenuator shall emulate 300 hundred foot fiber length, minimum, for multimode and 900 feet length, minimum, for single mode fiber or as specified by the OTDR manufacturer for stabilization of the pulse generation. Launch cables shall be of identical length for incoming and outgoing light during tests. ST/SC connectors shall be utilized with each attenuator to connect the device to the test device, OTDR. One launch cable shall be installed on the start of the fiber being tested and one launch cable shall be installed on the end of each terminated to view the dB loss of the final connector.

13.15.2 The OTDR shall have the Threshold Loss set at a value to show each splice or termination junction of a single fiber in each tube with out showing the extraneous noise caused by handhole coils or turns into the cabinets. This level is normally a value

[Threshold Loss] between 0.3 and 0.8 on the OTDR. This trace shall be provided for one fiber in each tube tested and each “event” shall be marked as to splice, jumper or patch cord. The Threshold Loss shall then be set to a value of 0.25 for multimode fiber tests and to a value of 0.10 for single mode fiber tests. The test of each fiber installed shall be conducted and any recorded events above this threshold shall be identified, such as jumper or patch cord. Events that are in excess the provided values shall be corrected prior to documentation submittal, such as terminations in excess of the rated value or bends in the fiber at the point of a splice entering of leaving the splice tray (See Testing). For measured values recorded in excess of the above (0.25 MM and 0.10 SM) listed values, refer to the fiber parameters specification as hereinbefore defined. The Engineer reserves the right to spot test fiber terminations, splices, or re-testing of all fibers in a section to insure proper quality assurance both during and after installation and testing. Deviations from Engineer testing and report documentation shall be reviewed and the Contractor shall be able to retest any or all challenged measurements to verify a valid test. Inconsistent test results, in the sole opinion of the Engineer, shall be cause for the Contractor to retest the entire fiber installation.

13.16 Testing

13.16.1 General

The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing and is considered incidental to the project. All testing shall be performed in an accepted manner and in accordance with the testing equipment manufacturer’s recommendations. All data shall be recorded and submitted to the Traffic Engineer as hereinbefore specified. The Contractor shall provide one copy of operating software to read and view all OTDR traces.

13.16.2 Attenuation

The end-to-end attenuation shall be measured for each fiber for each link after installation and termination. A patch cord jumper cable shall be connected to both the light source and the receive cable to the power meter by the use of a connector (barrel). The two reference cables shall then be connected via a termination coupler and the power meter “zeroed” to eliminate the line loss. This process results in a reading of the actual line loss (dB) of the input connector, fiber cable, exiting connector and any other splices or jumpers installed in the measured test link. The calculated “loss” shall not include the input or departing cables in the loss calculation. The calculated fiber loss measured shall list the number of terminations, including the input and departing connectors, the number of splices and the number of patch cords used to jumper the link(s) into the measured final link. The measured values for each terminated fiber in each tube shall include the Tube number, fiber number, number of feet in the link, the number of splices, the number of patch cords, and the number of connectors, if any. The length of optical cable shall be as measured by the OTDR rather than the fiber cable jacket as the fiber is a reverse oscillation process resulting in a greater optical distance than the fiber cable jacket. The value for both the OTDR length and the cable jacket shall be provided in the recorded documentation for each link distance. All distances shall be recorded in feet rather than

meters for both recorded lengths.

Fibers that are not continuous from beginning of the link to the end of the link shall be noted in the documentation; otherwise, all fibers in a single tube may be listed with a single data entry for all required data listed above for all fibers in the tube. The fiber documentation for each fiber shall identify the fiber being tested by either fiber number or fiber coating color and be recorded by complete tube, Tube 1 through Tube 6, fiber 1 through fiber 12. The direction of the test shall be recorded for information purposes only to resolve discrepancies in replicating the test during inspections of the final installation. The power meter reading recordings shall log total dB loss over the length of the fiber measured, equivalent to a dB loss budget.

The output power levels at the network hardware transmitters and receivers shall be measured and recorded for system documentation. The power meter shall be connected to the transmitter side of the equipment with a system jumper. The transmit power level shall then be read and recorded.

Each tube of a cable shall be in the same file divider where the tube cover OTDR page shows the overview of all splices, patch cords, terminations from start to end. The second section shall include all Power Meter readings and the mandated documentation to show the calculated line loss (losses). The third section shall contain all OTDR traces, one trace per screen. The fourth section shall include the spool sheet for the fiber installed on the test section. An “explanation” sheet may be included where required to clarify an unusual reading that is valid but difficult to be explained through traditional data presentation, such as a video feed fiber that is attached to a jumper to provide continuous feed from the start to end of the tube length where other fibers in the same tube are simply spliced. The above format shall be repeated for each tube of a cable.

13.16.3 Continuity

Continuity tests shall be used to determine whether a test or system jumper does or does not pass light. A continuity test shall also be used to assure the fibers have not been crossed over in the jumper and that the transmit fiber goes to the receiver fiber. The visible light tester shall be utilized to illuminate faulty terminations or fibers with excessive bends failing to pass light.

To perform continuity test, a high-intensity red light (Visible Fault Identifier) light source shall be aimed into the connector at one end, while an observer watches for a flicker of light at the other end. One each 650 nm red NFL light source shall be furnished to the Engineer by the Contractor on request during the testing of the fiber by the Contractor for spot testing**.** This device shall be made available during testing of continuity to the Engineer to assist in verifying fault locations and connector bleeding.

13.16.4 OTDR Testing

An Optical Time Domain Reflectometer (OTDR) shall be used to evaluate the quality and length of cable reels prior to their use on the project. A minimum of one fiber per tube per

reel shall be tested if payment for stored goods is requested. The fiber loss in dB/km and the length of each reel shall be recorded in the documentation. The maximum attenuation of the cable shall be as hereinbefore specified. This test does not require an electronic document; but is provided to insure that the fiber has been received in useable quality without shipment damage. The test results of the Contractor OTDR tests of received spools shall be provided to the Engineer, in a minimum of hard copy print, prior to receiving payment for stored goods.

An Optical Time Domain Reflectometer (OTDR) shall be used to evaluate the quality and length of cable installed on the project. This test shall be conducted on all fibers, terminated and not terminated, and shall be conducted after all terminations on the fibers for a link have been completed. The fiber loss in dB/km and the length of each reel shall be recorded in the documentation. The index of refraction, minimum of three decimal points, provided by the manufacturer on the spool documentation shall be used for the test on the OTDR. The maximum attenuation of the cable shall be as hereinbefore specified. A hard copy of OTDR signature traces, electronically and in printed form, for all fiber links shall be made and provided in the documentation as specified. The data provided shall be in easy to understand format and of sufficient detail to verify the results. Fiber testing shall include only one fiber trace per graph. One copy of the operating system software to view the fiber graphs shall be provided with the final documentation.

13.16.5 Documentation

The result of all testing shall be recorded along with date of test, name of person performing test, brand name, model number, serial number of equipment used during test, and any other pertinent information and data. The Contractor shall be responsible to provide input to the Engineer reviewing the recorded data documentation to resolve all questions or data discrepancies. A copy of the evaluation calculation equations to be used may be obtained by the Contractor by request and by supplying a floppy disk. (The evaluation FO Calculator is an EXCEL program worksheet that calculates design dB Loss based on required inputs.) Documentation shall be considered incidental to bid items and no additional compensation shall be provided. Fiber optic cable test results shall be provided to the Engineer, and the Johnston Public Works Director.

14. SERVER CABINET (INDOOR ENCLOSED RACK CABINET)

14.1 The traffic data center shall be provided with a self-contained floor mounted rack/server cabinet. Racks shall be EIA Standard nominal 19 inch rack mount assemblies, compliant with UL 1863, constructed of high-grade 6061-T6 aluminum or pre-approved equal, self-squaring, and self-supporting. All racks shall be pre-threaded 12/24 EIA holes for quick assembly and be provided with a minimum of 24 cross-recessed black panel mounting screws, 12/24 X 1/2 inch long. Each floor-mounted rack shall be provided with shelves that support a minimum of 120 pounds, be nominal 19 inch wide, 10.6 inch deep, or 17.4 inch deep and be double-sided, vented construction. Three shelves per rack assembly shall be provided to house equipment. Shelves shall be as specified by the Engineer for each rack. The floor-mounted racks shall be a minimum of 84 inch high, 15 inch floor base plate deep, and be provided with one cable manager installed.

The enclosed rack cabinet, complete with all accessories specified, shall be provided by the system integrator/ manufacturer or the designated representative.

14.2 All racks shall be drilled with a 5/8 inch, 5/8 inch, 1/2 inch universal hole pattern.

14.3 The enclosed rack cabinet shall be environmentally controlled and contained, i.e. a cooling system provided.

14.4 The rack cabinet shall house the servers, switches and termination panels, specified herein, to run the complete and functional traffic data center and traffic signal control system.

14.5 Contractor shall furnish and install terminations/ splice enclosures as shown on the fiber wiring diagrams.

15. ETHERNET COMMUNICATIONS SYSTEM

15.1 This specification sets forth the minimum requirements for an Ethernet based traffic signal interconnect and communications system. All work, equipment, and materials to provide a properly functioning Ethernet communications system is included.

15.2 The fiber optic Ethernet communications equipment shall include:

15.2.1 Switch, Ethernet Edge: Heavy Duty Switch shall be GarrettCom Magnum 6K Series with 1 Gb transmitters, or equivalent approved by the Engineer. The Ethernet switch shall be installed in the traffic data center cabinet. The number and type of ports shall be provided in order to run the traffic signal system outlined herein and provide for some expansion at a later time.

15.2.2 Switch, Managed: Each cabinet shall be equipped with a ten port managed Ethernet switch. The Ethernet switch shall be NEMA TS-2 rated. The switch will have six 10/100 Ethernet ports and four Single Mode Fiber ports. The switch shall be powered by AC line voltage. The Ethernet switch shall be a GarrettCom model 6KQE, or equivalent approved by the Engineer.

15.2.3 The Ethernet switch shall be attached to a side panel of the cabinet.

15.2.4 Patch cables to provide functional connection of the Ethernet switch to the Fiber Optic distribution panel and the signal controller shall be provided.

15.3 The system shall be primarily fiber optic cable based, but may include interface equipment to change from fiber optic communication to twisted pair copper wire communication. The system shall also include interface equipment and cabling for CAT-5 communications, except cable installed in conduit external to controller cabinet shall be CAT-6E.

15.4 All equipment, terminations, connectors, terminal blocks, and any other hardware to construct the system shall be designed for outdoor use in typical traffic signal system conditions. All equipment

shall include mounting brackets to secure the equipment in the cabinet.

16. PAN, TILT, ZOOM (PTZ) VIDEO CAMERA (IP PTZ DOME)

16.1 The Pan, Tilt, Zoom (PTZ) camera shall be an Axis Q6032e Weather Resistant Dome Network Camera. The PTZ camera shall be IP addressable and come with internet-based camera interface controls. The PTZ Camera shall have the following features:

16.1.1 Electronic Image Stabilization
16.1.2 35x optical zoom and 12x digital zoom, total 420x zoom
16.1.3 Lens: f=3.4 – 119 mm, F1.4 – 4.2, autofocus, automatic day/night
16.1.4 Horizontal resolution greater than 530 TVL (PAL)
16.1.5 Horizontal angle of view: 55.8 degree (wide end) to 1.7 degree (tele end)
16.1.6 Minimum illumination Color: 0.5 lux at 30 IRE F1.4, B/W: 0.008 lux at 30 IRE F1.4
16.1.7 Signal to noise ratio greater than 50dB
16.1.8 Electronic Image Stabilization up to 12dB suppression
16.1.9 Electronic shutter speed 1/30000 s to 1.5 s (50 Hz)
16.1.10 Operation temperature -40°F to 122°F, Humidity 10 - 100% RH (condensing)
16.1.11 Angular travel: Pan: 360 degrees endless, 0.05 degrees – 450 degrees/s
Tilt: 220 degrees, 0.05 degrees – 450 degrees/s
16.1.12 Manual mode speed: Pan variable from 0.10 degrees to 480 degrees/sec
16.1.13 100 presets per dome
16.1.14 Multiple, individually configurable streams in H.264 and Motion JPEG, controllable frame rate and bandwidth

16.2 Each PTZ camera item shall include the camera housing, and all mounting accessories for installation on a traffic signal mast arm and any cabling required connecting the camera into the controller cabinet.

17. TRAFFIC DATA CENTER EQUIPMENT

17.1 General
This work shall consist of furnishing and installing the equipment and accessories of the type and number specified. All equipment provided for the Traffic Data Center must be compatible with the TACTICS signal system software.

17.2 Desktop Workstation - Two desktop computers will be provided. The computers will be provided with all accessories to comprise a functioning workstation.

17.2.1 The accessories for each workstation include, but are not limited to, wireless keyboard, wireless mouse, and two 23 inch LED monitors.

17.2.2 Minimum computer specifications:
2.4 GHz Intel processor or better
6 GB RAM

160 GB hard drive
24x CDRW or DVDRW
10/100 Network Adapter

17.2.3 Software to be included on computer:
Microsoft Windows 7
Internet Explorer 8
Microsoft Office 2010

17.3 Mobile Workstation - One laptop computer will be provided. The computer will be provided with all accessories to comprise a functioning workstation.

17.3.1 The accessories for the mobile workstation include, but are not limited to, a wireless mouse, and nylon carrying case.

17.3.2 Minimum computer specifications:
2.4 GHz Intel processor or better
6 GB RAM
160 GB hard drive
24x CDRW or DVDRW
10/100 Network Adapter
Wireless network card
XGA and SXGA+ active matrix (TFT) Display

17.3.3 Software to be included on computer:
Microsoft Windows 7
Internet Explorer 8
Microsoft Office 2010

17.4 Wall Display - Two wall-mounted display screens will be provided. Each screen shall be a minimum of a 46 inch Class, LED, 1080p, 120Hz HDTV. The wall mounting bracket and installation shall be included. Screens shall be mounted at a location as directed by the project engineer or the Johnston Public Works Director. Connection to the workstations shall also be included.

17.5 A PowerRouter 732 router will be installed in the traffic data center server cabinet.

17.5.1 The router will have the following capabilities:
1U Rack Mountable,
Up to 5.9 Gigabits Routable throughput,
Seven Front Mounted Gigabit Ethernet Ports,
All Ethernet/Serial connections are front mounted,
Intel Pentium 4 Dual-Core 3.00 Gig Processor,
1 Gig DDR2 RAM, Level 4 Mikrotik License Installed,
1 x mPCI Slot for Wireless Cards,
1 x PCI Slot for T1, fiber, or four port Ethernet cards,

1 x Space for 2.5 gig HD

18. BASIS OF PAYMENT

18.1 No separate payment will be made for work covered in this part of the Specifications except as set forth below. Contract Unit Prices shall include all costs for each item of work.

18.2 If items, for which no Unit Prices are shown on Proposal, or Schedule of Unit Prices, are required during construction, Contract Price shall be adjusted on basis of Unit Price negotiated with Contractor.

18.3 The Traffic Signal Interconnect System will be paid for at the contract price bid, which price shall be full compensation for furnishing all equipment, materials, and all other work necessary or incidental to the construction of the complete traffic signal interconnect system installation and for all equipment, tools, labor, and incidentals necessary to complete the work.

18.4 The Contractor shall provide a 2 year warranty covering workmanship and materials after final acceptance of the project.