CITY OF BATON ROUGE
PARISH OF EAST BATON ROUGE

October 10, 2024

ADDENDUM NO. 1

TO: ALL BIDDERS

MAIN STREET AREA ADA TRANSITION PROJECT
(CITY PARISH PROJECT NO. 20-EN-HC-0047)

The following revisions shall be incorporated in and take precedence over any conflicting part of the original contract documents.

1. **REVISED BID DATE: TUESDAY, OCTOBER 22, 2024**
   BID TIME: 2:00 P.M.

   ORIGINAL BID DATE: TUESDAY, OCTOBER 15, 2024
   BID TIME: 2:00 P.M.

2. **CONSTRUCTION BID FORM:**

   1. For paper, sealed bidders, with reference to page UCBF 1 of 4 of Part 1, Uniform Construction Bid Forms, the Bidder shall indicate receipt of this Addendum in the space provided. Failure to indicate receipt of this addendum shall be cause for the bid to be rejected.

   2. Replace Unit Price Form with the attached Revised Unit Price Form (dated 10-08-2024). This revised Unit Price Form **MUST** be used by all Bidders for this project. Failure to submit on the revised Unit Price Form shall be cause for the bid to be rejected.

PART 2-SPECIAL PROVISIONS AND CONTRACT DOCUMENTS:

SECTION 1021 TRAFFIC SIGNALS

Delete this Section 1021 of the Standard Specifications in its entirety and replace with the following:

SECTION 1021
TRAFFIC SIGNALS

1021-1 SIGNAL HEADS:

1021-1.1 Traffic Signal Heads:

a. **General:** All traffic signal heads and all beacon heads shall be of the adjustable type. Materials and construction of both types of sections shall be the same, in accordance with the plans, and shall conform to the specifications that follow.

   Each traffic signal head shall consist of the assembly of all signal faces, sections, signal housing, LED optical units, visors, and backplate with reflective yellow band in the configuration(s)

specified on the plans and in accordance with the current adopted edition of the Manual of Uniform Traffic Control Devices (MUTCD). All equipment edges shall be deburred and smooth. All equipment contained herein and supplied shall be rated to withstand distortion in 130 mph winds and operate in the weather conditions for the location.

b. **Drawings and Literature:** The vendor shall furnish, with the first shipment on each order, two (2) copies of technical information, including drawings, parts lists, assembly instructions, etc., provided that the order is for ten (10) or more signal sections. If the order is for less than ten (10), one (1) copy of technical information shall be provided for each piece of equipment ordered.

c. **Guarantee:** The manufacturer shall guarantee the unit to meet the above specifications and operate in a satisfactory manner for one (1) year from the date of acceptance by the Traffic Engineering Division.

d. **Construction:** Die cast aluminum parts shall conform to ITE alloy S5 or SG3 of ASTM Specification B85-48T or the latest revision thereof. The exterior of the signal case, lamp housing, and mounted flanges shall be coated with high quality, baked enamel primer and finish paint.

The signal case shall be pre-drilled for backplates and visors. The hinge and latch pins shall be stainless steel. All access openings shall be sealed with weather resistant neoprene, or silicone, rubber gaskets.

Sheet metal parts, including visors and backplates, shall conform to ITE material requirements (Aluminum alloy not less than 0.05 inches - No. 18 Gauge).

e. **Finish:** All signal sections and mounting equipment, with the exception of gaskets, reflectors, terminal blocks, wiring, sockets, and span wire clamps, shall be finished both inside and out with two (2) coats of high-grade enamel. Each coat shall be independently baked to resist peeling and chipping. Factory provided powder coating is also acceptable. Visors shall match the rest of the signal head on the outside and non-reflective black on the inside. Finish samples shall be supplied upon request.

f. **Backplates:** Backplates shall be provided for all signal heads, unless otherwise specified on the plans. Backplates shall be designed and supplied by the manufacturer to fit the combination of sections of each signal head. Back-plates shall be constructed of ABS UV stabilized plastic sheeting and shall be firmly attached to each signal face to withstand the above wind load. They shall be non-reflective black in color and shall include a yellow, two inch (2”), retro-reflective border. Backplates shall be designed to fit each signal head with minimal visible gaps. Backplates shall mount on the main housing behind each signal face and shall not obstruct door opening. The width of a back-plate shall be a minimum of five inches (5”) and a maximum of eight inches (8”).

g. **Signal Sections:** Standard signal sections shall be constructed to contain a twelve inch (12”) LED indication and shall be used for all projects, unless otherwise stated. Signal sections shall be finished inside and out with two (2) coats of high-grade enamel with each coat independently baked. The color shall be specified on the plans.

h. **Signal Housing:** Housings shall be constructed of cast aluminum. If die cast, housings shall be constructed of aluminum alloy conforming to ASTM specification B-85 or B-108 and have a tensile strength of not less than 17,000 pounds per square inch (lbs/in^2). Housings shall also be clean, smooth, and free from flaws, cracks, blowholes, and other imperfections.

Housings shall be sectional, and each signal face shall consist of as many sections as there are optical units. Each signal face, combined with a suitable top and bottom, and with all sections being rigidly and securely fastened, shall produce one weather-tight assembly. Each signal section shall have round openings on top and bottom measuring 2 ± 0.004" after painting.

The complete assembly shall rotate about the centerline of the openings and shall be rain-tight without the use of sealing materials. A serrated edge shall be part of the section to provide positive locking in any direction in the horizontal plane. The serrations shall be such that any signal face will resist a torque of twenty (20) foot-pounds (ft-lbs) when assembled in accordance with manufacturer's recommendations.

The portion of the housing adjacent to the bracket shall be properly reinforced for sufficient strength against breakage from shock and wind damage. Labyrinths shall be provided at bracket attachment points and at section joints to ensure water shedding. Supporting brackets or trunnions shall be used at both the top and the bottom of each section assembly to rigidly support all faces.

Housing doors shall be of the same material as the housing. Each door shall be properly hinged and held securely to the body of the housing by simple non-corrosive locking devices that can be operated without the use of tools. All other door parts, such as hinge pins, lens clips, etc., shall also be of non-corrosive material or material treated to retard corrosion. Door hinge pins shall be designed to prevent the door from accidentally becoming disconnected from the housing when opened, regardless of the signal position. All doors shall be field removable with simple tools.

A weather-resistant, mildew-proof neoprene, or silicone rubber sponge gasket, shall be provided between the body of the housing and the doors for excluding dust and moisture.

i. **Signal Visor:** Each signal section shall have a cut-away visor tilting slightly downward from the horizontal unless tunnel visors are noted otherwise on the plans. All visors shall be of sheet construction, aluminum alloy, having a minimum thickness of 0.05" (No. 18 U.S. Gauge). Visors shall be coated with enamel on the outside with the same color as housing and black on the inside. All visors shall attach tightly to each section door with non-corrosive screws preventing any perceptible filtration of light between the door and the visor.

j. **Signal Indication**: The LED lenses shall meet the latest ITE Standard for Vehicle Traffic Control Signal Heads on performance and material. A certification from an independent laboratory shall be submitted as part of the literature with the bid. All lenses shall be clear, unless otherwise specified in the plans, made of ultraviolet stabilized material and must be durable on prolonged exposure to weather. It shall be free from streaks, wrinkles, chips, or bubbles that in any way detract from the lens efficiency or use.

Each LED indication shall be provided with (2) color-coded No.18 American Wire Gauge (AWG) stranded lead wires. The wires shall be Type TW (or approved equal) and shall be securely fastened to the LED indication. One terminal block shall be provided with each signal head. In addition, all wires shall be long enough to allow the LED to swing completely out of the housing without disconnecting any circuits.
All LED indications supplied shall comply with the latest following documents: Vehicle Traffic Control Signal Heads- Light Emitting Diode (LED) Circular Supplement (VTCSH), Adopted June 27, 2005, and in the Vehicle Traffic Control Signal Heads- Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement, MIL-STD-810F Moisture Resistance, MIL-STD-883 Mechanical Vibration and published by the Institute of Transportation Engineers (ITE).

k. **Manufacturer Requirements and Approvals**: The manufacturer supplying product to this specification shall have a minimum of ten (10) years of experience in the manufacture of LED Traffic Signals with High Flux LEDs used in the North American market.

Manufacturers supplying products to this specification must be a registered participant and have the unique long life module part numbers being provided certified and listed on the ***Intertek-ETL LED Traffic Signal Modules Certification Program*** approved products website prior to bid opening. Documentation of this shall be provided in the submittal package. In addition to the required ITE labeling all modules must be labeled with the ETL Verified label. This label shall designate the compliance and listing with the Intertek-ETL Traffic Signal Certification Program.

The base products must be listed in the Intertek Directory of LED Traffic Signal Modules Certified Products listing at the time of bid. The supplier must provide a copy of the listing in the submittal package. Upon Request, the supplier must provide an Intertek-ETL test report for the base model being supplied.

l. **Physical & Mechanical Requirements**:The LED signal indications shall be a single, self-contained device, not requiring on-site assembly for installation into existing traffic signal housings. The power supply must be designed to fit and mount inside the LED traffic signal indication. The external case shall be smooth on the outside to prevent excessive dirt/dust buildup.

The LED indication provided shall have non-tinted, clear lenses.

The LED indication shall utilize high flux LEDs rated at 1 watt or higher and have an incandescent, non-pixilated appearance when illuminated. The use of low power LEDs, for example 5 mm LEDs, is not permissible in the design and production of long-life arrow products.

All LEDs utilized to illuminate signal modules, shall be LEDs that have been manufactured utilizing materials that have industry acceptance as being suitable for uses in outdoor applications. At no time is the use of LEDs that utilize AlGaAs technology acceptable.

The thermal management system used in the traffic ball must be self- contained and internal to the signal indication. At no time shall the thermal management system used for the power supply or LEDs form any part of the external surface of the LED indication.

m. **Electrical**: The AC power leads shall exit the module via a rubber grommet strain relief and shall be terminated with insulated female quick connect terminals with spade / tab adapters. The leads shall be separate at the point at which they leave the module. The following color scheme shall be used for all modules AC power leads: White for Common, Red for the Red ball signal, Yellow for the Yellow ball signal, and Brown for the Green ball signal. All external wiring utilized in the LED traffic signal indications shall be anti-capillary type wire to prevent the wicking of moisture to the interior of the module.

LED indication and power supply shall be designed to remain ITE compliant over a fifteen (15) year life span. To minimize the temperature exposure of the power supply, all power supplies should be located at the bottom of the module. For additional protection from moisture, all power supplies shall be coated for additional protection.

In addition to the transient test requirements defined in the Design Qualification Testing section

of ITE VTCSH specification, all power supplies used in the circular signals supplied to this specification shall be capable of passing an additional ring-wave surge testing in accordance with the IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits, ANSI/IEEE C62.41.2-2002, 6KV, 100 kHz ring-wave with an output impedance of 30 ohms. The short circuit current shall be 200 Amps.

Typical maximum wattages at 25° C for the LED traffic Signal Modules for the 300 mm (12") balls the typical wattage at 25° C shall be; Red: ten (10) watts, Yellow: twenty-two (22) watts, and Green: ten (10) watts.

n. **Warranty Requirements**: Manufacturers shall provide a detailed written warranty issued by the factory of module origin. At a minimum, modules shall, at the manufacturer's option, be repaired or replaced if the module fails to function as intended due to workmanship or material defects or if the indication exhibits luminous intensities less than the minimum specified values within the first (5) years from the date of installation.

o. **Optically Programmed (Adjustable Face Traffic Signal Sections):** To be provided as required. Shall be similar to standard traffic signal heads, but will additionally be able to be programmed for precise lane control and high visibility. Masking of the programming lenses shall provide proper lane communication.

p. **Mounting (when specified or ordered separately):** Both signal and beacon sections shall be suitable for one (1) of the following standard mounting configurations. The type of mounting for each shall specify on the order:

q. **Span Wire:** There shall be two (2) basic components of span wire mounting hardware for signals: The span wire clamp and disconnect hanger. The cable clamp, consisting of a saddle (shoe), cable bar (protector), and two (2) "L" bolts with nuts and washers, shall attach to the span wire and to the tri-stud balancer to provide a horizontal pivot between the clamp and fitting(s) below the clamp. The attachment point of the clamp and fittings below the clamp shall consist of a ⅝" clevis opening and a ⅝" suspension (hanger) pin. The tri-stud balancer shall have a minimum of five (5), or a maximum of six (6), in-line positions, with one (1) position to be centered over the mechanical attachment point of the device. A serrated edge shall be provided on the attachment point of the tri-stud balancer to provide for positive locking in any direction in the horizontal plane. A balance adjuster assembly may be required for proper signal head positioning (see General Information Section – "Brackets and Balance Adjuster Assembly" for further details).

There shall be two (2) basic components of span wire mounting hardware for beacons: The span wire clamp and tri-stud hanger assembly. The clamp shall attach to the tri-stud hanger using the identical method as previously described for signals. The tri-stud hanger shall have a minimum of five (5), or a maximum of six (6), in-line positions, with one (1) position to be centered over the mechanical attachment point of the device. A weather-resistant, neoprene grommet shall be provided with the device. The grommet shall have two (2) "knockout" type openings to allow for a maximum of two (2) ½" signal cables into the device. The device shall contain a wire way to allow signal cables to pass through the device and into the beacon section. A serrated design shall be provided on the attachment point of the device to provide for positive locking in any direction in the horizontal plane.

r. **Pedestal:** Section shall be furnished as a slip fitter or banded installation, as needed, for placement on a four-inch (4") I.D. pipe pedestal utilizing setscrews for correct aligning of the signal. Provisions for base feed shall be incorporated in the design of the section assembly. Supporting brackets, trunnions and fittings may be made of cast aluminum, steel or cast iron.

All parts made of ferrous materials shall be treated to resist corrosion and match the rest of the signal heads.

The signal shall mount to a standard 1-1/2” fitting as a single section face, or in combination with other signals. The signal section shall be provided with an adjustable connection that permits incremental tilting from 0 to 10 degrees above or below the horizontal while maintaining a common vertical axis through couplers and mounting hardware. Terminal connections shall permit external adjustment about the mounting axis in 5-degree increments. The signal assembly shall be capable of being mounted and serviced with ordinary tools.

Attachments such as visors, backplates, or adapters shall conform, and readily fasten, to existing mounting surfaces without affecting water and light integrity of the signal.

s. **Brackets and Balance Adjuster Assembly:** Brackets utilized in the assembly of two- (2), three- (3), and four- (4) way signal sections shall be so constructed as to have the center of the face attachment points arranged on an 8-1/2” radius.

The bracket at the supported end of the signal section shall be of 1-1/2” conduit, or have an equivalent inside clearance, for electrical wiring. The bracket at the opposite end of the section may be either the same as the top or of solid construction. A setscrew locking device, or equivalent, that engages a drilled hole shall be provided at each joint on the bracket where conduit-type joints are used.

The balance adjuster assembly shall be fabricated from steel and iron alloys and shall be free of voids, pits, dents, molding, and excessive marks. All design radii shall be smooth and cosmetically acceptable, free of molding fins, cracks and other exterior blemishes. All material shall conform to current ASTM and ITE standards.

All material, with the exception of the clevis pin, shall be of galvanized steel construction. The clevis pin shall be of zinc coated steel material.

The eyebolt length shall be approximately 3⅛". The eyebolt shaft shall have ⅝"-11NC x 1-3/4" threads. The shaft shall be drilled for a ⅛" x ⅝" roll pin. (Note: The roll pin shall be installed after assembly to body to prevent accidental separation. The diameter of the top of the eyebolt shall be sized as required for containing a ⅝” eye opening.

The body length and width shall be approximately 2-⅞" and 1-3/4", respectively. The body shall be machined for ⅝" clevis pin, a ½” tightening bolt, and a 5/16"-18NC positioning set screw. A ⅛" slot shall be either cast or machined into the tightening bolt side of the body allowing the body to act as a hinge and tighten around the eyebolt. The setscrew, when tightened, shall allow the body to remain stable while securing the through bolt.

The balance adjuster assembly shall have a ⅝"-11NC nut and lock washer assembled onto the eyebolt shaft. The eyebolt is to be threaded into the body and secured with a 5/16"-18NC square head set screw. The roll pin shall be installed into the eyebolt shaft to prevent accidental separation. A ½”-13NC x 2½” hex head bolt, lock washer, and hex nut shall be assembled into the tightening portion of the body. A ⅝" x 2" clevis pin and 5/32" x 1½” cotter pin shall be installed through the clevis portion of the assembly.

t. **Plugs (Rosette Cap / with neoprene plug):** All unused openings shall be closed utilizing standard 1-1/2” inch threaded plugs with a neoprene gasket. All openings shall have a watertight seal. The minimum length shall be 1-1/2 inches long and shall not interfere with any internal parts.

All plugs made of ferrous material shall be treated to resist corrosion and shall match the signal heads in color and finish.

1021-1.2 Pedestrian Countdown Signal Heads:

a. **General:** The pedestrian countdown signal shall consist of a housing, hinged door, LED module message lens, blank-out Z-crate sun visor, and required hardware and shall be in full MUTCD compliance. The design shall provide optimal energy performance and be ADA compliant.

The pedestrian signal shall be capable of displaying both brightly and uniformly while subjected to powerful ambient light conditions. Under the same light conditions, the message(s) shall blank-out when the signal is not energized.

b. **Position of Signal Indications:** The pedestrian signal indications shall be configured in a single housing using a 3-Symbol/2-Color message LED module. The position of each indication shall be included in the shop drawing submittal for approval by the Traffic Engineering Division. International Symbol indications, the upraised "HAND" and the "WALKING PERSON", shall be used along with the countdown symbol. The indications "DON'T WALK" and "WALK" shall not be acceptable.

c. **Housing:** The housing shall be constructed from one (1) piece of die cast, corrosion resistant, aluminum alloy complete with integrally cast top, bottom, sides, and back. The housing details shall be included in the shop drawing submittal for approval by the Traffic Engineering Division. The fully constructed housing shall be free from any defects. Four (4) integrally cast hinged lug pairs and two (2) flanges shall be provided. Two (2) lug pairs located on the top and two (2) on the bottom, equally spaced, to allow the door to swing open. All mounting locations within the housing shall be symmetrical. The housing shall provide a dust-proof and weatherproof enclosure when properly mounted.

Housings shall be provided with two (2x) 2" ports. One (1) port shall be located on the top and one (1) on the bottom. Each port shall have a 72-feet boss integrally cast to eliminate rotation or misalignment of the signal. All teeth shall be clean and sharp to provide full engagement and positive locking with standard signal mounting equipment and hardware. Reinforcing ribs shall be provided to project load-bearing stress.

d. **Door/Visor Frame:** The door shall be die cast construction of one (1) piece, corrosion resistant, aluminum alloy. The door shall mount to the housing by use of clevis pins, eyebolt/wing nut assemblies, and flanges. Each eyebolt shall be held securely to the housing and include one (1) wing nut. The clevis pins, together with the eyebolt and wing nut assemblies, shall be designed to allow the door to latch and unlatch without the use of tools. The door shall include an additional frame, molded as a part of the door, to protect and hold a visor.

e. **Visor:** A visor shall be provided with each signal and attach to the doorframe by use of metal screws. The visor shall be constructed of black Lexan material, or approval equal, having a crate-type design to provide protection against vandalism and ultraviolet radiation. When installed properly, the visor shall be parallel to the message-bearing surface. When the indication on the message-bearing surface is illuminated, the illuminated message shall be viewed entirely, without shadows, by the pedestrian when the pedestrian is within a minimum ten degrees (10) left or right of a line perpendicular to the message-bearing surface.

f. **Messages:** Message configuration shall be the solid "HAND" symbol internally illuminated via

LED with a Portland Orange color source on the left half of the MBS (message bearing surface, a solid "WALKING PERSON" symbol internally illuminated via LED with a lunar white color source on the left half of the MBS, and a countdown symbol internally illuminated via LED with a Portland Orange color source on the right half of the MBS.

The "HAND" and "WALKING PERSON" symbols shall each be a minimum 11" (279 mm) in height and 7" (178 mm) in width. The height of the countdown symbol shall be a minimum of 9". Message configuration, color and size shall be as defined by the latest I.T.E. Equipment Standard "Pedestrian Traffic Signal Control Indications". Internal illumination shall be provided by LED.

Pedestrian LED traffic signal modules shall be designed for the message bearing surface of a 16" x 18". Pedestrian traffic signal housing built to the PTCSI Standard. The message-bearing surface of the module shall be supplied with a fully populated "HAND" and "MAN" symbol, with the individual LED's being visible, that comply with PTCSI standard for these symbols for a message-bearing surface of the size specified. This message-bearing surface shall be designed so that it can be removed from the sealed unit for replacement without further damage to the module.

g. **Optical Assembly:** LED pedestrian signal modules shall not require special tools for installation. LED pedestrian signal modules shall fit into the existing traffic housings built to the VTCSH Standard without any modification to the housing. Installation of a replacement LED module into the existing pedestrian housing shall only require the removal of the existing optical unit components. Each pedestrian module shall have a sticker attached stating compliance to the ITE Standard for color.

h. **Pedestrian LED Signal Lens:** The lens of the LED pedestrian signal modules shall be field replaceable. The lens of the LED pedestrian signal modules shall be polycarbonate UV stabilized and a minimum of 3/16 inch thick. The exterior of the lens of the LED pedestrian signal module shall be smooth and frosted to prevent sun phantom.

i. **LED Pedestrian Signal Module Construction:** The LED pedestrian signal module shall be a single, self-contained device, not requiring on-site assembly for installation into signal housing. All Portland Orange LEDs shall be "AlInGaP" technology or equal, and rated for 100,000 hours or more at 25ºC and 20 mA. "ALGaAS" technology is not acceptable. All internal LED and electronic components shall be adequately supported to withstand mechanical shock and vibration from high winds and other sources. The signal module shall be made of UL94VO flame-retardant materials. The lens is excluded from this requirement. Each individual LED traffic module shall be identified for warranty purposes with the manufacturer's trade name, serial number and operating characteristics, i.e., rated voltage, power consumption, and volt-ampere.

j. **Environmental Requirements:** The LED pedestrian signal modules shall be rated for use in the ambient operating temperature range of 40ºC to +74ºC (-40ºF to +165ºF).

The LED pedestrian signal modules shall be protected against dust and moisture intrusion per requirements of NEMA Standard 250-1991, sections 4.7.2.1 and 4.7.3.2, for type 4 enclosures to protect all internal LED, electronic, and electrical components.

k. **Luminous Intensity:** Each module shall provide a minimum luminous intensity after five (5) years of at least 1,400 candela per square meter of lighting surface for the "HAND", and 2,200 candela per square meter for the "WALKING PERSON" symbol throughout the warranty period over the operating temperature range. The maximum starting luminous intensity shall be

no more than three times the minimum luminous intensity. The luminous intensity of the LED pedestrian signal indication shall not vary more than ± 10 % for voltage range of 80 VAC to 135 VAC.

l. **Chromaticity:** The measured chromaticity coordinates of the LED signal indications shall conform to the chromaticity requirements of latest ITE PTCSI – LED Modules

m. **Electrical:** The secured, color coded, 914 mm (36 in) long, 600V, 20 AWG minimum, jacketed wires, conforming to the latest National Electrical Code, rated for service at +105ºC, ½ inch stripped and tinned are to be provided for electrical connection. The LED pedestrian signal module shall operate from a 60 ±3 Hz AC line over a voltage range of 80 VAC to 135 VAC. Rated voltage for all measurements shall be 120 ±3 volts rms. The LED circuitry shall prevent perceptible flicker over the voltage range specified above. The LED pedestrian signal module circuitry shall include voltage surge protection against high-repetition noise transients and low-repetition noise transients as stated in Section 2.1.6, NEMA Standard TS-2, 1992.

Catastrophic failure of one LED light source shall not result in the loss of more than the light from that one LED. The LED pedestrian indication shall be operationally compatible with the currently used controller assemblies. The LED pedestrian indication shall be operationally compatible with conflict monitors. The LED pedestrian module including its circuitry must meet Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of noise.

The LED pedestrian indication shall provide a power factor of .90 or greater over the operating voltage range and temperature range specified above for modules with 6 watts or more. Total harmonic distortion (current and voltage) induced into an AC power line by an LED pedestrian module shall not exceed 20% over the operating voltage range and temperature range specified above. For abnormal conditions when nominal voltage is applied to the unit across, the two-phase wires (rather than nominal voltage being applied to the phase wire and the neutral wire), the pedestrian signal unit shall default to the upraised hand symbol.

n. **Warranty:** The unit shall be repaired or replaced by the vendor/contractor if it exhibits a failure due to workmanship or material defect within the first five (5) years from the date of installation. The unit shall be repaired or replaced if the intensity level falls below the requirements specified in luminous intensity part a, within five (5) years from the day of installation.

o. **Finish:** All signal sections, with the exception of LED, gaskets, terminal blocks, wiring, visors, and hardware, shall match in color and finish as called in the plans. Each coat shall be independently baked to resist peeling and chipping.

p. **Hardware:** All signal hardware shall be of stainless steel construction.

1021-2 TRAFFIC DETECTORS AND EQUIPMENT: Vehicle detection shall be used for vehicle detection on actuated phases/movement of signal operation. Pedestrian ADA compliant push buttons shall be used as pedestrian detectors.

1021-2.1 Loop Detectors: Detector units shall meet or exceed NEMA TS1, Section 15 and NEMA TS2 specifications for inductive loop detectors. Detector units shall be suitable for accurate detection of vehicles from bicycles to tractor-trailer combinations which ordinarily travel public streets and highways with sufficient conductive material, located to permit recognition and response by detector system. Loop detectors shall “fail safe” in a manner such that if the loop shorts or degrades in usable quality, the unit shall place a recall on that individual loop input to the controller.

Rack mounted four (4) channel detector card shall be provided, as needed per plans. There shall be a minimum of three (3) selectable frequencies, switchable on front of unit. They shall be self-tuning and shall retune to new inductance value if large inductance change occurs. There shall be a minimum of twelve (12) selectable sensitivity levels to be adjusted using switches on front of unit. Each switch on unit shall be labeled with its use. Unit shall contain a fault and detection LED display on front of unit. Unit shall provide, at a minimum, pulse and presence detection and have an EIA-232 communications port.

1021-2.2 Video Detection Camera System With Integrated Radar Detection:

a. **General:** A Video Detection Camera (VDC) system may be used to provide real time detection of vehicles on the roadway. The VDC system shall relay the presence detection to the signal controller in real time and shall operate in NEMA TS-1 and TS-2 signal controller cabinets. The Integrated Radar Detection System shall provide advanced detection (Volume/Density Detection) to the signal controller cabinets.

   The VDC system shall support Ethernet communications for transfer of video and data. Using a client-server relationship, the VDC system shall provide a communications interface into the existing communication server application. This shall be accomplished using standard TCP/IP network protocols. It shall be possible to remotely view real time operation of the VDC system with visible detection zones to indicate on / off state of detector zone.

b. **VDC System Hardware:** The VDC system shall consist of the following components:
   1. Video Detection Camera (Sensor)
   2. Integrated Radar Unit & Video Detection Camera (Sensor)
   3. Video Detection Modular (Rack-Mount) Communications Panel
   4. Video Detection Cable

   The video detection camera shall have resolution of at least 480p (720x480 pixels) video in real time to detect vehicles and extract traffic data and transmit the detector outputs without noise to degrade video detection. The camera shall have minimum of 10x optical zoom without affecting the detection zone. It shall provide streaming video with detector overlay. All video detectors shall follow the manufacturer's installation instructions for mounting height and be installed in the location most optimal for detection, utilizing extender arms, where needed.

   The modular communications panel shall plug directly into a NEMA detector rack. It will use standard inputs and outputs to communicate with the traffic signal controller. The wiring termination panel shall provide transient voltage protection for the cabinet interface and the video detection camera using fuses. It shall provide connection to the local user via a USB port, and a 10/100 Mbps Ethernet port and a DHCP capable Wi-Fi access point.

   The Video Detection camera shall utilize an Ethernet cable to provide power and communications from the Communications Panel to the Video Detection Camera using IEEE standard Power over Ethernet (PoE) protocol. Power filtration and surge suppression for the PoE connections shall be provided as part of the system.

c. **Integrated Radar Unit:** The Detection system shall have an integrated radar unit to be used to detect vehicles, bicycles, and pedestrians up to 600'. The Radar unit shall share the same enclosure as the camera and have only one mount power/communications point.

d. **VDC System Software:** The VDC system software shall provide, but not be limited to, the following applications: diagnostics, TCP/IP addressable, streaming video, programmable video

detection using Boolean logic and vehicle counts. The detection shall be reliable under all lighting and weather conditions. The system shall allow secure, remote access for configuration, maintenance, and video streaming.

e. **Video Streaming:** The VDC system shall have the ability to stream video via management software in quad view or through third party applications on a tablet, smartphone, or laptop.

f. **Detection Zone Programming:** Detection zones shall be user programmable, superimposed on image of approach. Each zone shall be user defined, shall provide flashing overlay to indicate on / off state and programmable using Boolean logic. Detection zone types shall be, but not be limited to, the following: vehicular and bicycle presence and counts, and differentiation by lane or wrong way detection.

   All detection zone overlays and label data can be shown or hidden based on user's needs. If the video image is lost or becomes unusable by the VDC system, the outputs of the VDC shall place a failsafe recall on the affected phase or phases.

g. **Data Collection:** The collection of data, counts, alarms, etc. shall not interfere with the normal operation of the VDC system. The data collected shall include, at a minimum; vehicle counts per zone, turning movements independent of the zone, average speeds, vehicle lengths, pedestrian counts, and bicycle counts. The VDC software shall be able to retrieve the collected data for a specified period of time and be saved into a standard file format.

h. **Power:** The VDC shall operate normally over an input voltage range of 120 VAC at 60 Hertz (HZ). Power consumption shall be no more than sixteen (16) watts. No supplemental surge suppression shall be required outside the cabinet.

i. **Environmental:** Shall operate at temperatures -30° F to +165° F and shall be capable of operating within weather conditions in Louisiana. Must be constructed so as to be waterproof to the IP67 standard. It shall conform to the NEMA TS-2 standard. Mount shall withstand 130mph wind load.

j. **Installation and Training:** The supplier of the VDC system shall supervise the installation and programming, as needed by the contracting agency. The supplier will provide training to the contracting agency as needed or as contracted to do so. A User's Guide and Tech Notes will be made available with the supplied equipment digitally.

k. **Warranty, Service and Support:** All VDC system components shall be warranted for a minimum of three (3) years. All software/firmware updates will be provided free by the system supplier for the life of the unit. A technical support phone number shall be provided by the supplier for free technical support for the life of the system.

1021-2.3 Wireless Magnetometer Vehicle Detection System:

a. **General:** This special specification sets forth the minimum requirements for a wireless magnetometer vehicle detection system (WMVDS) that detects vehicles on a roadway via changes to the earth's magnetic field. When a change is detected, the WMVDS provides contact closure to a traffic controller or similar device.

   The WMVDS shall consist of the following components: In-pavement sensors, all wireless communication equipment needed to establish communication links to the controller cabinet, interface modules compatible with NEMA TS-2 V2.06b cabinet detector rack, surge protection for the WMVDS and system software for set-up and monitoring of the WMVDS. Supplier or

manufacturer must provide all system software and materials necessary for installation and maintenance of the WMVDS. Supplier must provide documentation for the use of software, installation instructions, and maintenance of the system.

b. **3-Axis Magnetometer**: Instrument used for measuring the magnitude and direction of the earth's magnetic field. Device used to detect changes in the earths magnetic field within the vicinity of the instrument. The 3-axis magnetometer measures the height, width and length of the magnetic field around the instrument referenced as the X, Y, and Z axis.

c. **Interface Module:** Module used to plug into the detector rack of a NEMA TS-2 traffic controller cabinet or input file 170/2070 traffic controller cabinet. Provides contact closure to the assigned detector channel when vehicle detection is achieved by the in-pavement sensor.

d. **Wireless Communications Link**: Data communications channel connecting to nodes of a communications link using a radio frequency (RF) to connect the nodes. Wireless links to connect nodes such as: access point to the sensor and/ or access point to repeater.

e. **Access Point**: Wireless communications device used as the connecting node to establish a data communications link from the sensor to the interface module.

f. **Repeater:** Wireless node used to receive/transmit data with the access point. Repeater is typically located near the sensor and may be used in tandem with another repeater for longer distances or to communicate around obstructions.

g. **In-pavement Sensor**: Device placed in the roadway and used to detect a change in the ea1th's magnetic field when a vehicle passes over its measured area of influence. In-pavement sensor houses the 3-axis magnetometer used to sense the change in the earth's magnetic field. Sensor acts as a data communications device to an access point to transmit contact closure when detection is achieved by the 3-axis magnetometer. In pavement sensors may also be referred to as a sensor in this specification.

h. **System software**: Computer software used for set-up and monitoring of the WVMDS. Software allows the user to assign sensors to detector channels and to select sensitivity levels needed for the application.

i. **Detection zone:** Area of measured magnetic lines of flux by the in- pavement sensor.

j. **Presence Detection:** The ability of a vehicle detector to sense that a vehicle, whether moving or stopped, has appeared in its zone of detection.

k. **Passage Detection:** The ability of a vehicle detector to detect the passage of a vehicle moving through its zone of detection and to ignore the presence of a vehicle stopped within its zone of detection.

l. **Detection Accuracy**: The measure of the basic operation of a detection system (shows detection when a vehicle is in the detection zone and shows no detection when there is not a vehicle in the detection zone).

m. **Delay Timing:** When selected, applies delayed contact closure to the associated detector channel input. When a vehicle is detected by the WMVDS, the delay timing must time out before contact closure can occur to the detector channel.

n. **Extension Timing**: When selected, applies additional contact closure to the associated detector

channel input. When a vehicle is no longer detected within a detection zone, extension timing must time out before contact closure is removed from the associated detector channel.

o. **Hysteresis:** The lagging of an effect behind its cause; especially the phenomenon in which the magnetic induction of a ferromagnetic material lags behind the changing magnetic field.

1021-2.3.1 Functional Capabilities: The WMVDS must be capable of detecting a variety of vehicle types including motorcycles, automobiles, large trucks and light rail trains. The system must allow the user to select sensitivity levels that adjust the amount of hysteresis to the magnetic field needed to achieve contact closure to the assigned detector channel. Magnetometer sensitivity level adjustments must allow for different levels of vehicle detection. Sensitivity level settings to the magnetometer must be accomplished using WMVDS software via wireless communication.

The WMVDS must be able to perform presence or passage detection as described in this specification.
The WMVDS must be able to perform delay and extension timing as described in this specification.

Equipment failure such as: the sensor, communications link, access point radio, repeater radio (if used) or interface module, shall result in constant vehicle call "fault state" on the affected detector channel to the traffic controller. Equipment must fail safe.

1021-2.3.2 Detection Performance: Detection accuracy must be comparable to properly operating inductive loops. Detection accuracy shall include the WMVDS ability to detect the presence of any vehicle within the sensors magnetic field and to communicate contact closure to the appropriate detector channel. If the WMVDS "false detects", (system applies contact closure when a vehicle is not present in the sensors magnetic field), this will count against the accuracy measured during perfo1mance testing. A minimum of 97% detection accuracy must be achieved by the WMVDS when measured in a twenty fourhour (24 hr) period.

The WMVDS shall provide real-time vehicle detection (within 150 milliseconds (ms) of vehicle arrival). Once detection is achieved by the sensor, the traffic controller must receive contact closure to the assigned detector channel within the 150 ms time frame.

1021-2.3.3 In-Pavement Sensor: The in-pavement sensor unit shall to operate reliably in adverse weather conditions and rated to operate from -30 F to + 165 F.

In-pavement sensors must be capable of presence detection as defined in this specification. The in-pavement sensors as a minimum must create a six foot length by six foot width (6’ x 6’) accurate area of detection when used for presence detection at an intersection.

The in-pavement sensors as a minimum shall create a six six foot length by six foot width (6’ x 6’) accurate area of detection when the sensors are set back from the intersection for passage detection on an arterial.

In-pavement sensors shall use a 3-axis magnetometer. The sensor shall monitor the earth's magnetic field throughout the course of the day and establish a baseline reference value for the X, Y, and Z axis with a minimum refresh rate on the magnetometer's processor of sixty-four hertz (64 HZ) and reference the earth's magnetic field every three minutes (3 min) updating the baseline value for vehicle detection. The sensor shall be able to detect a change in the magnetic field as referenced to the sensitivity setting selected by the user and the size of the vehicle passing over its detection zone.

The in-pavement sensor must operate on batteries without wired power or communications lines.

The average life span of the sensor under battery power shall be a minimum of ten years (10 yrs).

1021-2.3.4 Detector Interface Module or Magnetometer (Sensor) Controller Unit: The access points shall

communicate to an interface module plugged into the detector rack or use shelf mounted sensor controller with a RS485 and 2.4 GHZ communication interface. The interface module or the sensor controller shall provide detector contact closure date to the traffic controller. The sensor controller shall use a NEMA TS-2 SDLC connector addressable from the traffic controller.

The operating temperature range of the interface module or sensor controller, as a minimum must be -30°F to +165°F.

The interface module shall be designed to operate in a NEMA TS-1 or NEMA TS-2 detector rack. The interface module must be capable of operating on twelve-volt (l2V) DC and/or twenty-four volt (24V) DC (detector racks may be wired for twelve volt (l2V) or twenty four (24V) DC).

The sensor controller shall be designed to interface with the RS485 communications in a NEMA TS-1 or NEMA TS-2 cabinet and be addressable with the traffic controller using a SDLC connection point in the cabinet. The sensor controller shall communicate contact closure to an assigned detector channel in the traffic controller when vehicle detection is achieved by a magnetometer. As a minimum the sensor controller shall be able to collect and transmit contact closure data from sixty-four hertz (64 HZ) in pavement sensors to assigned vehicle detector channels in the traffic controller.

The interface module shall provide four (4) detector channels. Sensors shall be assignable to the available detector channels on the interface module using software provided with the WMVDS.

The front face of the module shall identify detector channel 1 and detector channel 2. Each shall use an LED to indicate contact closure on the channel. When vehicle detection is achieved, the LED will be on and contact closure applied to the detector channel. During periods of no vehicle detection the LEDs shall be in an off state and no contact closure will be applied to the detector channel.

The interface module shall use an LED indication to indicate a "fault state" with the WMVDS. When the fault state is active contact closure shall be applied to the approp1iate detector channel.

Sensor controllers shall apply contact closure when communication to an in pavement sensor is lost for a period of sixty to seventy five seconds (60-75 sec) in order to fail safely. Contact closure shall be applied on the detector channel until communication to the sensor is reestablished with the unit.

A link light or the use of a software GUI shall be used to indicate a valid communications link is established between the interface module and access point. If no link is established between the two devices, the interface module shall apply contact closure to all detector channels.

1021-2.3.5 Communication Requirements: Access points and repeaters shall be rated for outdoor use and housed in an approp1iate NEMA enclosure. The operating temperature range of these devices, as a minimum, must be from -30°F to +165°F.

As a minimum, access points shall be capable of handling data communications for forty-eight (48) sensors. The access points must be able to communicate to sensors from a distance of one hundred fifty feet (150') when mounted twenty feet (20') above the road surface. Repeaters may be used to achieve distances above one hundred fifty feet (150') out to one thousand feet (1,000').

All communication s equipment shall operate in an unlicensed frequency range permitted by the FCC.

The communications system shall have alternative frequency channels selectable by the user. The device must be capable of switching to an alternate channel free of interference, should interference occur on a frequency channel.

All communications equipment shall meet all applicable IEEE standards and FCC standards as required for the frequency range used by the WMVDS.

Surge protection shall meet the Electromagnetic Compatibility and Electrical Safety - Genetic Criteria for Network Telecommunications Equipment GR 1089 standards for devices receiving power over Ethernet.

Equipment shall be able to operate from power over Ethernet (48Vdc) or an external 120Vac source.

1021-2.3.6 Software: Firmware for in-pavement sensors and access points shall be upgradable via a wireless connection to the device and be upgradeable after installation in the pavement without damaging the pavement.

The software shall allow for sensitivity adjustments to the sensor detection algorithms used by the WMVDS. As a minimum, the system shall use twelve (12) different sensitivity levels ranging from 0.12 to 25.6, change in milli-gauss of the measured magnetic field. The sensitivity adjustments shall be selectable by the user. Contact closure shall be transmitted to the interface module when a change to the magnetic field is equal to or greater than the selected sensitivity setting.

The software shall allow the user to program delay time within a range of 0 to 25 seconds.

The software shall allow the user to program extension time within a range of 0 to 5 seconds.

The software shall allow the user to assign selected sensors to specific detector channels via system software.

The software shall be capable of displaying each sensor, sensor vehicle detection activity and its communication status on a GUI display.

Software shall show battery level and received signal strength indication (RSSI) for each in pavement sensor used at the intersection in real time.

1021-2.3.7 Warranty: A five (5) year warranty on all parts and components of the entire wireless Magnetometer Vehicle Detection System (WMVDS) shall be provided by the manufacturer. The warranty shall begin when the Wireless Magnetometer Vehicle Detection System (WMVDS) is installed.

1021-2.4 Pedestrian Pushbuttons: Pedestrian pushbuttons shall consist of an ADA compliant push button and a single momentary contact switch. Cast metal housing shall include fittings for ½" conduit on back. Operating voltage for pedestrian pushbuttons shall not exceed twenty-four (24) volts DC.

Assembly shall be weatherproof and constructed so that it will be impossible to receive electrical shock under any weather condition.

Button activation shall not require more than two (2) pounds of pressure and button target area should be at least two inches (2") wide and be embossed with a tactile arrow indicating direction of crosswalk.

When a pedestrian pushbutton is attached to a pole, housing shall be shaped to fit the curvature of pole and shall include the required pedestrian sign housed in the same frame as the pushbutton. Should a decorative pole be used the button assembly must allow adjustment to meet ADA height requirements for push button and sign in the same module.

When a pushbutton is to be top post mounted, a slip fitter housing shall be provided with screws for securing to post.

1021-2.5 Accessible (Audible/Tactile) Pedestrian Pushbutton Detector: The accessible pedestrian

(Audible/Tactile) pushbutton detector must consist of all electronic control equipment, wiring, mounting hardware, pushbuttons, and pedestrian actuation signs designed to provide both a pushbutton with a raised, vibrating tactile arrow on the button as well as a variety of audible indications for differing pedestrian signal functions.

a. **Electronic Control Equipment**: The accessible pedestrian pushbutton detector must include electronic control equipment that is programmable and adjustable using a laptop computer or vendor supplied programmer. Electronic control equipment must be able to be installed within a traffic controller cabinet or within a pedestrian signal housing. Electronic control equipment installed within a traffic controller cabinet must allow the use of up to 16 pushbuttons (4 maximum per channel) with a single traffic controller cabinet. The accessible pedestrian pushbutton detector must receive timing from Walk and Don't Walk signals.

b. **Audible Messages:** Audible messages must be programmable. All audible messages and tones must emanate from the accessible pedestrian pushbutton housing. The accessible pedestrian pushbutton detector must utilize digital audio technology. The system shall have, at a minimum, three programmable locator tones. The accessible pedestrian pushbutton detector must have independent minimum and maximum volume limits for the Locator Tone, Walk, and Audible Beaconing features. The Wait message must only annunciate once per actuation.

c. **Pushbutton locator tone:** The accessible pedestrian pushbutton detector must provide independent ambient sound adjustment for the locator tone feature. The accessible pedestrian pushbutton detector must allow the locator tone to be deactivated.

d. **Vibrating Pushbutton (VPB):** The accessible pedestrian pushbutton detector must include a Vibrating Pushbutton (VPB). The VPB must be a single assembly containing an ADA compliant, vibro-tactile, directional arrow button, weatherproof audible speaker and pedestrian actuation sign with optional placard Braille messages. The VPB tactile arrow must be 2 inches in length, be field adjustable to two directions, and require no more than 5 pounds of applied force to activate.

e. **Conflict Monitoring:** The accessible pedestrian pushbutton detector must monitor the Walk condition for conflict operation. The accessible pedestrian detector system must disable the Walk functionality if a conflict is detected.

f. **Cabinet Control Unit (CCU):** The accessible pedestrian pushbutton detector may include a CCU for interfacing and connecting the system. The CCU shall have labeled LED indicators for each channel operation. The CCU must reset upon loss of internal communication.

g. **Inputs and Outputs**: All inputs and outputs must use Mil-Spec Multipin connectors.

    1. **Inputs:** Walk and Don’t Walk inputs must be optically isolated 80-150 volts AC/DC, 5mA max. General purpose inputs must be optically isolated 10- 36 volts AC/DC, 10mA max.

    2. **Outputs:** Outputs must be optically isolated 36 volts AC/DC peak, 300mA solid state fused contact closures. CCUs must include a normally open relay contact fault output.

h. **Communication:** The CCU must include an Ethernet interface. The CCU must have an integral web server that provides information on audible/tactile pedestrian pushbutton detector status, access to event logs, and provides for remote Configuration of accessible pedestrian pushbutton detector system options. VPBs must include an Ethernet, serial, or USB programming interface.

i. **Electrical:** All wiring must meet applicable NEC requirements. The accessible pedestrian

pushbutton detector must operate using a nominal input voltage of 120 volts alternating current (VAC). If any device requires nominal input voltage of less than 120 VAC, furnish the appropriate voltage converter. Accessible pedestrian pushbutton detector control electronics that are mounted in a pedestrian signal head must be able to receive power from the Walk and Don't Walk circuits of the signal head. Voltage at the pushbutton shall not exceed 24 VAC.

j. **Mechanical:** Equipment must be permanently marked with manufacturer name or trademark, part number, date of manufacture, and serial number. Do not use self-tapping screws on the exterior of the assembly.

Ensure that all parts are made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal. Ensure that all assembly hardware, including nuts, bolts, external screws and locking washers less than 5/8 inch in diameter, are Type 304 or 316 passivated stainless steel. Stainless steel bolts, screws and studs must meet ASTM F593. Nuts must meet ASTM F594. All assembly hardware greater than or equal to 5/8 inch in diameter must be galvanized. Bolts, studs, and threaded rod must meet ASTM A307. Structural bolts must meet ASTM A325.

Enclosures must have a NEMA 4X rating. Pushbutton housings for intersections must be black.

k. **Environmental:** Ensure equipment performs all required functions during and after being subjected to the environmental testing procedures described in NEMA TS2, Sections 2.2.7, 2.2.8, and 2.2.9.

l. **Warranty:** The contractor shall provide the manufacturer's warranty information with shop drawing submittal.

m. **Construction Requirements:** Install pedestrian detectors at the locations and in a manner as shown in the Plans. Ensure all detectors are the same manufacturer and model. Pushbuttons mounted on wood poles must be serviced by a conduit riser. Pushbuttons mounted on steel or aluminum (poles, pedestals, or posts) must be serviced by wiring inside the pole. A R10-3a 9" x 12" pedestrian actuation sign with LADOTD Type X sheeting must be included with each pushbutton assembly, unless otherwise specified on the plans. Tactile arrows of accessible pedestrian pushbuttons must align parallel with the direction of the crossing.

The Engineer will direct any variation from the locations shown. When mounting, place the detector housing or saddle in complete contact with the pole or controller cabinet. When a post is required in the installation of the pedestrian detector, restore the area around the post to its original condition or as required by the Plans.

1021-2.6 Rectangular Rapid Flashing Beacon (RRFB) Assembly: The following shall comply with Federal Highway Administration (FHWA) Interim Approval 21 – Rectangular Rapid Flashing Beacons at Crosswalks.

- Signs - Sign sheeting shall also comply with City-Parish sheeting requirements.
- Flashing Beacons
- Pushbuttons - Mount ADA compliant pushbutton detectors
- Communication - Shall also be via hardwire interconnect using conductors as shown on the plans.
- Operation - All RRFBs within a single crosswalk must start and stop simultaneously. Assemblies and their materials shall be able to operate within a temperature range of 32 degrees to 120 degrees Fahrenheit. Assemblies shall be rated for 90 mph wind conditions.

a. **Pole:** Use Pedestal Poles and foundations in accordance with City-Parish Standards unless approved otherwise. Install foundations flush with the sidewalk.

b. **RRFB Controller Cabinet:** NEMA 3R type aluminum enclosure with a minimum thickness of 0.125 inches, or cast aluminum alloy. Provide a cabinet with adequate space for the control electronics Provide ventilation louvers to prevent the accumulation of gases and to promote airflow for internal components. Provide aluminum screening, with perforations that shall not exceed 0.125 inches in diameter, to prevent insects and other foreign matter from entering. Install rubber mats on the bottom of the cabinet and two (2) 1/8-inch drain holes located in the bottom at opposite corners.

   The door and its opening shall encompass and constitute the entire area of the face of the cabinet. It shall be hinged via a continuous tamper resistant stainless steel hinge which shall be riveted to the door and to the cabinet. The door shall be tightly secured via a latching device which pulls the door snugly against a neoprene gasket affixed to the cabinet body forming a weather-tight seal. The door shall be equipped with a locking device.

   A label shall be visible and applied to the interior, and include system specific information including model number, serial number, date of manufacture, as well as any applicable regulatory compliance information.

c. **RRFB Control Components:** Mount the back panel to the inside of the cabinet. Mount all electronic components within the cabinet to the back panel. The electronic components shall be easily installed or removed with simple hand tools.

1021-3 SIGNAL HARDWARE AND EQUIPMENT:

1021-3.1 Miscellaneous Hardware: Screws, nuts, and lock washers shall be stainless steel or galvanized in accordance with ASTM A 153. No self-tapping screws shall be used unless approved.

1021-3.2 Support Cable: Support cable for interconnect and detector support cable shall be 1/4" diameter, and signal support cable and guy wire shall be 3/8" diameter. Cable shall conform to ASTM A 475, 7-strand Simmons-Martin grade with Class A coating.

1021-3.3 Guy Components: Guying components and hardware shall be galvanized in accordance with ASTM A 123 or A 153.

Guy clamps shall be steel, 3-bolt type, 6" in length and of proper strand size to fit both sizes of cable. Clamp bolts shall have an upset shoulder fitting into clamp plate. Refer to Standard Details 906-03.

1021-3.4 Conductors:

1021-3.4.1 Traffic Signal Cable: Cable shall be 600-volt insulated cable. Filler material shall be non-metallic, moisture resistant, non-hygroscopic, non-wicking and non-absorbent. Conductors that are to be marked with tracer in addition to solid color shall have tracer as part of insulation; ink marking is not acceptable. Outside jacket shall not display patterns of conductor lay.

Signal cable shall be No. 14 AWG stranded conductor. Material, color code and testing shall conform to IMSA 20-1. Interconnecting cable between intersections for closed loop shall be single mode fiber optic cable or as noted otherwise.

1021-3.4.2 Loop Lead-In Cable: Loop lead-in cable shall be tinned No. 14 AWG stranded conductor, twisted pair with overall shield. Cable shall conform to IMSA 50-2. Loop detector wire shall conform to IMSA 51-3. Insulation shall be 0.080" XLPE.

1021-3.4.3 Flashing Beacon and Advanced Warning Flasher Cable: Flasher cable shall be No. 12 AWG

stranded 4 conductor. Material, color code and testing shall conform to IMSA 20-1.

1021-3.5 Junction Box:

a. **Electrical Junction Box:** Refer to City-Parish Standard Details 906-01 for additional information.

   Concrete collar shall conform to Section 1005. Reinforcement shall consist of welded wire fabric, 4" x 4" No. 4/4 conforming to Subsection 1006-1(e). Junction boxes shall be precast concrete or composite such as Quazite, or approved equal.

1021-3.6 Conduit: All underground conduits including elbows shall be HDPE or PVC schedule 80. The contractor shall use an E-LOC coupling to connect HDPW to PVC. All conduit connections shall be sealed with a waterproof sealing compound. Conduit cannot be more than 270 degrees of bends in conduit without a junction box.

Rigid galvanized steel conduit shall conform to current NEC Code, UL Safety Standard 6, and ANSI C80.1 specifications. Ends of metallic conduit shall be reamed after threads are cut. All ends shall be cut square and shall butt solidly in the joints to form a smooth raceway for cables.

Threads shall be clean cut, straight and true of sufficient length to permit full depth coupling. Excessive threads will not be permitted. Damaged coatings in exposed threads shall be repaired. Exposed threaded ends of conduit shall be terminated with an insulated throat, ground type bushing.

1021-3.6.1 Pulling Cable Through Existing Conduit: This Item consists of installing conductor cable into existing underground conduit. Use appropriate installation techniques such that the cable is not degraded. Unless otherwise approved by the Engineer, use only the equipment and procedures specified by the manufacturer of the cable. Install the cable in such a way that neither the minimum bending radius nor the maximum pulling tension are violated before, during, or after installation.

The Contractor shall take every precaution to ensure that the cable is not damaged during storage and installation. The Contractor will not allow workers to step on the cable or run it over with any vehicle or equipment. The Contractor will replace and reinstall any cables that are damaged at no additional cost to the project.

Cable runs shall be continuous between allowable termination points in controller cabinets or splice cabinets. Splices are not allowed in conduit, junction boxes or manholes. An exception to this requirement is a detector lead-in cable, which shall be spliced to loop wire in the junction box adjacent to the saw cut.

All conductor cable slack shall be in the junction boxes in accordance with EBR Specifications and Standard Details.

No separate payment will be made for equipment used to install, terminate and test the cable, the cost of which shall be included in the unit price to furnish and install the cable in an existing conduit. The unit price for cable shall also include all cable ties, clamps, and other hardware required to install the cable.

Underground Installation: Before any underground cable installation is performed, provide the Engineer with a copy of the cable manufacturer's recommended and maximum pulling tensions for each cable size and type. These pulling tensions shall be specified for pulling from the cable's outer jacket. Also provide a list of the minimum allowable cable bending radius and the cable manufacturer's approved pulling lubricants and guidelines for their application. Only these lubricants will be permitted.

The installation must be inspected and approved by the Engineer. Do not pull the cable along the ground, over edges or corners, over or around obstructions, or through unnecessary curves or bends. Use approved cable guides, feeders, shoes and bushings to prevent damage to the cable during installation.

Pull the necessary length of cable to be installed from one junction box, manhole or cabinet, to the immediate next downstream junction box, manhole or cabinet. Carefully store the remaining length of cable to be installed in the next conduit in a manner that is not hazardous to pedestrian or vehicular traffic yet ensures that no damage to the cable occurs. Store the cable in a manner that allows that length of cable to be safely pulled into the next conduit. Use a storing method that is approved by the Engineer.

1021-3.6.2 Pulling Fiber Optic Cable Through Existing Conduit: This Item consists of installing fiber optic cable into existing underground conduit. Before any underground cable installation is performed the contractor shall provide the engineer with the cable manufacturer's recommended and maximum pulling tensions for each cable reel. These pulling tensions shall be specified for both pulling from the cables and for pulling from the cable's outer jacket. Included with these pulling tensions shall be a list of the cable manufacturer's approved pulling lubricants. Only those lubricants will be permitted.

Cable shall be installed by hand-pulling methods or approved acceptable mechanical methods that do not exceed pulling tensions specified by the cable manufacturer. Approved cable guides, feeders, sleeves, shoes and/or bushings shall be used to prevent damage to the cable during installation. Cable shall not be pulled over edges or corners, over or around obstructions or through unnecessary curves or bends. Cable shall enter the pullbox or hole directly from the reel or storage stack and shall be pulled directly out of the immediate next downstream pullbox, hole, or cabinet.

When installing the cable using a pulling eye, the maximum allowable pulling tension for the cable installation shall be the cable manufacturer's recommended pulling tension for pulling from the pulling eye, or eighty percent of the manufacturer's maximum pulling tension for pulling by the outer jacket, whichever is smaller. A dynamometer, reviewed and accepted by the engineer, shall be used to ensure that the maximum allowable pulling tension is not exceeded at any time during installation. Cables shall be looped in and out of cabinets and pullboxes to provide adequate slack and the least amount of stress on conductors and connectors as possible.

The contractor must comply with the requirement that a maximum of forty percent of the cross-sectional area of the conduit shall be utilized for pulling fiber optic cable. If number of cables exceeds this maximum capacity requirement, the contractor shall immediately notify the engineer of the situation. The contractor shall bear all liability for installing cable resulting in violation of this percent full requirement.

Existing cable that is to be abandoned in conduit shall be taped and capped at the cable's termination points and shall be labeled as abandoned. Existing cable identified for removal shall be removed and disposed unless indicated otherwise in the plans.

1021-4 POLES:

1021-4.1 Pedestal Poles:

1021-4.1.1 Pedestal Signal Support Poles (Non-Decorative): Base of pedestal shall be cast iron or aluminum and shall be at least sixteen inch (16”) wide at the bottom, at least sixteen inch (16”) high and shall be octagonal.

Pedestal Anchor Bolts: Steel anchor bolts shall be fitted with 1 hex nut and 1 washer. Nuts, washers, and anchor bolts along their entire length shall be completely galvanized in accordance with ASTM A 153.

Upper end of base shall be threaded to receive a 4” diameter pipe shaft.

Pedestal Base shall be designed so that it may be fastened to foundation using anchor bolts located 90° apart on

circumference of 12 ¾".

Shaft outside diameter shall be 4 1/4" welded steel tubing with a minimum 1/8" wall thickness. Lower end of shaft shall be threaded to screw into base. Shaft shall be single piece tubing.

Pedestals shall be finished with at least one (1) coat of rust proofing primer and one (1) coat of enamel.

Length of pedestal, shaft plus base, shall be a minimum of eight (8) feet, unless otherwise directed by the project engineer.

1021-4.1.2 Pedestal Signal Support Poles (Decorative):

Length of pedestal, shaft plus base, shall be a minimum of eight (8) feet, unless otherwise directed by the project engineer. See note above about ADA pushbutton height modification.

1021-4.2 Steel Signal Support Pole:

a. **General:** Poles and fittings shall be galvanized in accordance with ASTM A 123 or A 153. Poles shall be suitable for a minimum horizontal load of 4,000 pounds applied one (1) foot below top of pole.

b. **Pole Shaft:** Pole shaft shall have a base diameter to accommodate required foundations as specified in the Standard Pole Foundation Details. Pole shaft shall be tapered to approximately eight-inch (8") diameter at top. Pole shaft may have a round or octagonal cross section. A cap shall be used to cover pole shaft top.

   Pole shall be designed so that its maximum deflection is as follows:

Pole Length Ft	Maximum Deflection in./100 lb
26	0.25
28	0.30
30	0.38

c. **Handholes and Bosses:** A handhole shall be provided approximately 18" above base with approximate dimensions of 4" x 6-1/2" and cover shall be provided. Cover shall be restrained to pole with a 15" stainless steel chain fastened to cover and to inside of handhole so that chain will be inside pole after cover is installed on pole. There shall be no sharp edges on cover, in handhole, or in pole. Cover shall have manufacturer's name and pole height stenciled on it, readable from outside of pole. Stencil shall be legible after galvanizing. Handhole strain bar shall be formed to provide a mechanical lock against handhole to prevent turning. No obstructions shall be in handhole with cover removed. A grounding nut (1/2"-13NC) shall be welded to inside of shaft 90° left horizontal from handhole. A grounding lug shall be provided with each pole and be centered 90° to the left and horizontal from handhold. Handhold should be at 180° from street.

   Each Pole shall have a one-inch (1") and three inch (3") boss centered on a horizontal line twenty-four (24") from base. When facing bosses, one inch (1") boss shall be a maximum of 35° to right of three-inch (3") boss. The three-inch (3") boss shall be located 180° from handhole. Bosses at top of pole shall be in line with bosses at bottom. Bosses at the top of the pole shall have a 1x 1" and 2x 3" bosses centered on a horizontal line eighteen inch (18") from pole cap. Poles shall be shipped with bosses plugged using galvanized steel conduit plugs installed to full thread depth. On octagonal pole, three-inch (3") boss shall be centered on one

(1) face that is parallel to one (1) edge of base plate. Refer to City-Parish Standard Plans 906-03 for additional information.

1021-4.3 Steel Poles and Mast Arms:

a. **General:** Mast arm materials shall conform to the following.

1.	Shaft	-	ASTM A570-50 (50,000 PSI Min. Yield)
2.	Base Plate	-	ASTM A36 Min.
3.	Anchor Bolts	-	ASTM F1554
4.	Anchor Nuts	-	ASTM A563 Finish Pattern
5.	All other bolts	-	A325 or A307

Poles, mast arms, and fittings shall be galvanized in accordance with ASTM A123 or A153. Pole height shaft dimensions and wall thickness shall meet specified design requirements and mounting height of signals.

Poles shall consist of straight or uniformly tapered shafts, cylindrical or octagonal in cross section, having base welded to lower end with anchor bolts. Castings shall be clean and smooth with details well defined and true to pattern. Mechanical control shall prevent arm from twisting on shaft; friction is not acceptable.

Couplings located in the arms for wire entrance shall have conduit threads with removable steel pipe plugs. Shaft and arm shall be stamped to identify "Fit" side. Matching serial numbers shall be stenciled on pole shafts, mast arms after galvanizing. The serial numbers to be assigned by City Parish and installed by manufacturer.

Mast arms over forty-foot (40') shall be made of two (2) sections.

Pole shafts to be sized by manufacturer. Structures are to be designed to AASHTO Specifications (110mph). An AISC certified manufacture shall provide stamped and signed shop drawings and structural calculations for each pole per the plans for review and approval prior to ordering.

Mast arms shall be compatible with poles in materials, strength, shape, and size. Mast arms shall slip fit, bolt, or clamp onto shaft.

b. **Handholes and Bosses:** A handhole shall be provided for access to wireway at union of arm and pole shaft. Bosses shall be 1-1/2" FPT in mast arm and set at 45° from horizontal (downward rotation at center of boss, 0° toward arm top). Bosses shall be located a horizontal distance of ten (10) feet apart, the first located sixteen inches (16") from top of arm. Number of bosses required is listed in the following table.

Arm Length, ft.	Number of Bosses
10-20	2
25-30	3
35-50	4
55-70	6

c. **Hanger Plate:** A hanger plate and horizontal boss shall be at tip of arm. Arms shall be at tip of arm. Arm shall have an up-sweep design. Design load on arm shall be sufficient to place a signal

head at each boss.

d. **Design Requirements:** For establishing loads applied to each structure, the following weights and projected areas shall be used for signal heads:

*SIGNAL HEAD TYPE	Design Weight Per Signal (LB)	Projected Area Per Signal with Backplates (SQ FT)
3 SECTION	74	8.67
5 SECTION	123	13.33

*When signal heads of a type different from that shown above are used, weights and projected area shall be increased for equipment proposed for use. Adjusted values shall be based on use of twelve-inch (12") diameter LEDs and backplates (when used) extending five inch (5") beyond signal enclosure.

e. **Standard Shaft:** Standard shaft base shall have a minimum diameter of eight inch (8").

f. **Wireways:** Pole shaft and mast arm shall be suitable for wireways throughout their length.

g. **Structural Steel Coating Systems for New Structures:**

1. **High Performance Coating Systems (Decorative - Color Pigmented):**

   i. Prime Coat: Zinc dust pigment shall be a minimum of Type II in accordance with ASTM D520. Inorganic zinc rich primers shall meet the requirements of the Society for Protective Coatings (SSPC) Paint 20, Type I, Level 2
   ii. Finish Coat: The finish coat shall provide the color and gloss required for the completed coating system. A finish coat shall be comprised of a single pigmented coat.

2. **Inorganic Zinc Coating System:** Zinc dust pigment shall be a minimum of Type II in accordance with ASTM D 20. Inorganic zinc rich primers shall meet the requirements of SSPC Paint 20, Type I, Level 2. The performance requirements for gloss and color retention are not applicable.

h. **Structural Steel Coating Systems for Existing Structures:**

1. Prime Coat: Zinc dust pigment shall be a minimum of Type II in accordance with ASTM D520. Urethane zinc rich primers shall meet the requirements SSPC Paint 20, Type II, Level 2.
2. Finish Coat: Finish coating shall provide the color and gloss required for the completed coating system and be comprised of a single pigmented coat.

i. **Galvanized Steel Coating System.** Coatings applied over galvanized steel shall meet the outdoor exposure requirements of the above Performance requirements with the exception that test panels shall be galvanized in accordance with ASTM A123 prior to application of subsequent coatings.

j. **Painting Strain Poles, Mast Arms, Pedestals and Monotube Assemblies:** Paint systems used on galvanized steel strain poles and pedestals, galvanized steel mast arms and galvanized steel

monotube assemblies shall meet the color requirements as specified in the Contract Documents and shall exhibit no loss of adhesion or loss of color greater than 8ΔEs for five years after final acceptance. A galvanized steel strain pole, mast arm or monotube assembly that exhibits a cumulative surface area of delamination in excess of 100 square inches will constitute an adhesion failure. Delamination shall be defined as any area of exposed metal surface subsequent to hand tool cleaning in accordance with SSPC-SP2. A change in the coating color in excess of 8ΔEs per the CIT L*a*b* 1976 will constitute a color retention failure. The owner will measure the CIT 1976 color chromaticity coordinates for the color of the top coat of the two sample coupons provided with a BYK-Gardner Handicolor colorimeter using D65 illuminant and 2 degree geometry settings. The Department-measured L*a*b* chromaticity coordinates shall define the initial color and will be used for resolution of color retention failures and resolution of color retention disputes. All paint systems shall possess physical properties and handling characteristics that are compatible with the application requirements. Materials shall be specifically intended for use over galvanized steel. The finish coat shall be comprised of a single pigmented coat.

1021-4.4 Treated Timber Poles: Poles shall conform to Section 1013.

1021-5 TRAFFIC SIGNAL CONTROLLER AND CABINET:

1021-5.1 Traffic Signal Controller: Contractor shall submit product submittal to the DPW Chief Traffic Engineer for approval prior to ordering equipment. All new traffic signal controllers and software shall be compatible with existing traffic signal controllers in the EBR Traffic System.

1021-5.1.1 980 ATC Controller with Ethernet Port: This specification sets forth the minimum requirements for a sixteen-phase full-actuated traffic signal controller unit with internal Time-Based-Coordination (TBC), railroad/fire/transit emergency vehicle preemption, and closed loop secondary operation. The traffic signal controller unit shall fully comply with the latest publicized draft for NTCIP Object Definitions for Actuated Signal Controllers and work with the existing Baton Rouge computerized Traffic Signal System.

a. **Controller Unit:** The actuated traffic controller shall be NEMA TS-2 compliant, and shall meet or exceed the latest draft requirement for the following National Transportation Communications for ITS Protocol (NTCIP):

   1. NTCIP 1101 (formerly TS 3.2)—Simple Transportation Management Framework (STMF).
   2. NTCIP 1201 (formerly TS 3.4)—Global Object Definitions.
   3. NTCIP 1202 (formerly TS 3.5)—Objects for Actuated Traffic Signal Controllers.
   4. NTCIP 2001 (formerly TS 3.3)—Class B Profile

   Interpretation and definition of compliance to this specification shall be at the sole discretion of the agency.

b. **Hardware Design Requirements – NEMA Controller:** The controller shall meet or exceed all requirements of the latest NEMA TS2 Standard.
   1. The supplier shall provide a test report summary, letter, or certificate of compliance from an independent testing laboratory certifying controller compliance to NEMA TS2.
   2. The controller shall operate on an AC input power voltage from 89 to 135 Vrms, and input power frequency of 60 +/- 3 Hz.
   3. The controller shall have an operating temperature range of -30o to +165o F, and an operating relative humidity range of up to 95%.

4. The controller shall meet the Standard NEMA configuration as NEMA TS2 Type 2 for direct parallel connection to load switches and detectors, fully backward compatible with NEMA TS-1 Type 1 equipment.
5. In addition to latest NEMA requirements, the Central Processor Unit (CPU) shall be incorporated on an "Engine Board" compliant with the hardware requirements of the ATC Standard, version 5.2b and provide the following:
6. The Engine Board shall include and use the Linux operating system
7. The Engine Board processor shall be a Freescale PowerQUICC processor of the 82xx or 83xx families.
8. The Engine Board shall be rated at 500 MIPS minimum at the CPU clock rate used. The main memory (DRAM) shall not include wait-states and shall be full-bus-width.
9. The Engine Board shall have a minimum of 64MB DRAM.
10. The Engine Board shall have a minimum of 128MB Flash Memory storage.
11. The controller shall include a licensed copy of V76 Software and not require additional hardware to run the intersection application software.
12. In addition to the latest NEMA requirements, the power supply and/or host board shall provide the following:
13. Line Frequency Reference (LFR) signal shall be by crystal oscillator, which will synchronize to the 60 Hz AC incoming power at 120 degrees and 300 degrees. A continuous square ware signal shall be provided at +5 VDC amplitude, 8.33 ms half-cycle pulse duration, and 50 +/- 1 percent duty cycle.
14. The LFR shall compensate for missing pulses and line noise during normal operation. The LFR shall continue through 500 millisecond power interruptions.
15. Standby voltage shall be maintained by super capacitor. No batteries of any type shall be used.
16. In additional to the NEMA requirements, the keyboard and display shall provide the following:
17. The display shall be an LCD type and shall provide a minimum of 8 lines by 40 characters. It shall incorporate a backlight.
18. The display contrast shall be temperature-compensated and adjustable by use of two dedicated keypad keys. One key shall lighten the contrast, the other shall darken it.
19. The keypad shall provide, inherently, both tactile and audible feedback ("click") when keys are pressed. Spacing between key centers shall be 0.6 inch minimum for operation keys and 0.5 inch minimum for contrast adjust keys. Membrane style keypads shall not be provided.
20. The keypad shall include a minimum of 23 keys.
21. NEMA TS2 serial ports P1 and P2 shall be provided, and serial port P3 shall be supported. In addition to these requirements, the controller shall provide the following communications functions:
22. All serial communication ports shall be integral to the controller. ATC/2070 Communication slots shall not be utilized or provided.
23. An asynchronous FSK modem, if required, shall be internal to the controller chassis. The FSK modem option(s) shall support up to 9600 baud. The FSK modem shall be hardware-configurable to be attached to serial ports SP1 and SP2 of the Engine Board.
24. An EIA-232 connector shall be available for serial port P3 in lieu of the FSK option. If the FSK modem is installed, the EIA232 connection may still be used. The controller shall sense when an appropriately wire cable is attached to the EIA232 connector and automatically disable the internal FSK modem.
25. Two additional EIA232 ports shall be provided for interfacing to other devices. These shall be routed to SP2 and SP8 of the Engine Board.
26. The controller shall provide a 10/100 Ethernet RJ-45 port with status indicators for Link/Activity and 10/100 speed. The LED indicators shall be water-clear and high-brightness with a minimum luminosity of 90mcd for visibility in high-ambient-light conditions.

27. The controller shall provide a USB port for Memory Storage Device support per the ATC v5.2b standard. It shall support USB 2.0 Full-Speed operation.
28. In addition to the NEMA requirements, the controller housing shall conform to the following:
29. The physical size shall not exceed 15 inches wide by 9 inches deep by 10 inches tall.
30. The TS2 Type 2 controller shall provide the following:
31. I/O connectors A, B, C, D
32. SDLC (Port 1)
33. EIA-232 (Port 2, 3)
34. FSK (Port 3), if required
35. For the TS2 Type 2 configuration, the "D" connector shall be a 57-pin circular connector that mates with AMP (Tyco) part number 206437-1.
36. The NEMA A, B, and C receptacles mounted on the front panel shall have the receptacle keys in the upright (12 o'clock) position.
37. All input and output pin assignments for connectors A, B, and C shall have the capability to be mapped to any NEMA input and output functions, respectively.
38. The TS2 Type 1 controller shall provide the following:
39. I/O connector A (10-pin)
40. SDLC (Port 1)
41. EIA-232 (Port 2, 3)
42. FSK (Port 3)
43. The TS2 Type 1 10-pin "A" receptacle shall have the receptacle key in the upright (12 o'clock) position.

c. **Time Clock:** The clock shall use the sixty (60) Hz power line frequency as time base when AC power is present over the 89-135 VAC range defined by NEMA TS-2 Section 2.1.2. A super capacitor shall maintain the time-of-day clock and digital data during a power outage lasting up to two (2) consecutive days (forty-eight (48) hours). The use of batteries to maintain power to the time clock is unacceptable as means of compliance with this section. The Time Base clock shall be maintained to within 0.005% at 20C and to within 0.02% over the full specified operating temperature range, as compared to GPS standard for a period of thirty days, during periods when AC power is not applied. The time clock shall be continuously updated by a GPS unit located within the cabinet.

d. **Program Requirements:** Programming of the controller unit shall be by the use of the keyboard and display on the front of the controller unit. Navigating various features shall require only simple keystrokes, aided by full menu displays.

The menu structure shall be well organized for ease of programming. It shall contain a main menu, which contains keyboard options for all sections of the controller on one screen. Each option shall be selectable by either a numeric entry or combination cursor positioning and ENTER key entry. Each subsequent menu shall be a detailed breakdown of one of the previous menu options. Each menu option shall be a descriptive name to prompt the user to the desired section for programming. All entries shall be displayed and entered in plain English. Toggle type entries shall be set by entering YES/NO or ON/OFF responses. Non-alphanumeric symbols and abbreviations will not be used to display information. For example, phase start up interval cannot be represented by a 0 = green, 1 = yellow, etc. All entries must state Red, Yellow, etc. in plain alpha symbols. Numeric entries shall be in the Base 10 (decimal) number system. Entries in other number bases, such as hexadecimal or binary, are not acceptable.

Each of the NEMA timing intervals shall be programmable for all eight phases from the same display screen in a spreadsheet format. The display may be rolled or paged down to display additional intervals or information.

A user selectable minimum four-digit access code shall be an available option for securing access to timing and configuration of the unit. Display features shall be made available without the need to password access the unit. The controller unit shall be supplied with the code factory preset to be all zeros (0000).

Instructions for use or entry of the access code shall not be printed on the face of the controller.

A keyboard entered coded command (a series of commands or entries, not a single entry) shall be provided which will set all controller and TBC timings and entries to a default or inactive value. This coded command shall allow new values to be entered without first deleting prior entries.

With the intersection display active, a keyboard command shall enable the user to place a call to each phase individually.

e. **Phase Operation:** In the NEMA operating mode, the controller unit shall accommodate a minimum of sixteen (16) phases and sixteen (16) overlaps. The overlaps shall be designated as A, B, C, D, E, F, G, H, I, J, K L, M, N, O and P. All overlaps shall be programmable through the keyboard and shall function as described by NEMA TS 2 Section 3.5.8.

Each of the NEMA TS-2 timing intervals shall be programmable for a minimum of eight (8) phases at a time from the same display screen, in a spreadsheet format. The display may be scrolled or paged down to display the next eight (8) phase banks, additional intervals, or related information.

The controller unit shall have a copy mode, allowing the user to easily copy programmed interval information into remaining phases.

In addition to NTCIP 1202 requirements, the following modes shall be available on a per phase basis:

1. Conditional Re-service
2. Walk Clearance through Yellow
3. Red Rest
4. Max II
5. Allow conflicting phases, 2 entries per phase (Alternate Sequences)
6. Next Phase if power up in the Yellow Interval

The following configurations, as a minimum, shall be programmed within the controller unit and be user selectable:

User Mode defined by the operator

- 8 Phase NEMA
- 8 Phase Sequential
- NEMA phasing to the left of barrier, sequential phasing to the right of barrier (Quad Sequential).
- 4 Phase Diamond Interchange
- 3 Phase Diamond Interchange
- Separate Intersection B (2) four-phase intersections

The controller shall have a configuration which allows a minimum of four (4) user programmable rings (compatibility lines, reference points shall be provided to assure there shall

be no concurrent selection and/or timing of conflicting phases).

The controller shall have programmable conflicting phase settings where simultaneous operation of compatible phases is not allowed.

A Phase Dynamic Maximum operation which increments the current maximum in programmable steps (Dynamic Max Step) in seconds to a maximum limit (Dynamic Max Limit) in seconds shall be provided. The operation shall function as defined by NTCIP 1202.

The TBC shall select and coordinate reversible left turn sequence operations (dual leading, leading and lagging, or lagging and leading left turns). It shall be possible to transfer operation from one sequence to another at a preprogrammed time. Transfer shall take place at T0 during coordination.

f. **Coordination:** A minimum of 64 timing patterns, each with a unique cycle length and offset combination, shall be available. Each of the 64 timing patterns will select one of the 16 possible split plans. Cycle length selections are to be each changeable from 30 to 255 seconds, in one-second increments. Phase split times and offset selections are to be adjustable from 0 to 254, in 1-second increments.

The coordinator shall reference a system -wide reference cycle timer (system cycle timer). The term T0 shall refer to the point in the local cycle timer when the first coordinated phase (or leading coordinated phase if a pair of coordinated phases was selected by the user) is scheduled on for the first time. Note, this may not be the beginning of Green in the case of early return. The offset shall be the time in seconds that the local cycle timer lags the system cycle timer. For example, if the offset is +10 seconds, T0 (the point at which the local cycle timer is at 0) will occur when the system cycle timer is at 10 seconds.

An entry shall be provided that will allow the automatic modes of coordination to reference either the beginning of the coordinated phase to local cycle zero or reference the end of the coordinated phase to local cycle zero.

The controller shall contain the two modes of automatic coordination programming, fixed and floating force off modes, as required by NTCIP 1202 entries. The following information shall be all that is required from the user to establish a pattern:

1. Basic NEMA controller timing
2. Cycle length in seconds
3. Desired phase sequence for the particular pattern
4. Total seconds of the cycle that a phase is to be active, including green, amber and red clearance times when there is constant demand on all input detectors
5. The coordinated phase or phases.
6. The offset of the first coordinated phase serviced in the sequence from the reference clock's T0 in seconds
7. Cycle length in seconds.

Using the above information in fixed force -off mode, the coordinator must perform the following functions for each pattern.

1. Guarantee the coordinated phase(s) programmed time will be serviced in their entirety to achieve coordination between intersections (when not correcting). The programmed time of the first coordinated phase in the phase sequence shall start at T0.

2. Calculate each phase's force off point (the point at which a phase's Green must terminate, in order to not violate the following phases' programmed times).
3. Calculate the beginning of each phase's permissive window (the point in the cycle when the coordinated phase is allowed to yield to each corresponding phase).
4. Calculate the end of each phase's vehicle permissive window (the point preceding a phase's force off point by its minimum time and the prior phase's clearance time). Any phase receiving a vehicle call before the end of vehicle permissive window will be serviced during the current cycle.
5. Calculate the end of each phase's pedestrian permissive window (the point preceding a phase's force off point by pedestrian Walk and pedestrian clearance times and the prior phase's clearance time). Any pedestrian call received by a phase before the end of pedestrian permissive window will be serviced during the current cycle up to the beginning of the phase vehicle green.
6. Guarantee that each phase's programmed time is serviced in full if a call was received before the beginning of permissive window, and the phase does not terminate due to Gap out.

Using the same information in floating force -off mode, the coordinator must operate in the same manner as fixed force -off mode, except that if a non-coordinated phase is entered early, it will remain active only for the time programmed in the split time. Automatically setting the max timer in each split to accomplish this function is acceptable.

Once the user-selectable data for phase service is entered, the controller unit shall test the plan to ensure that the plan does not violate any minimum times based on the specified numbers and cycle length. If a faulty plan is detected, the controller unit shall show an error code indicating the problem. If the error is not corrected, the controller unit shall run in free operation mode whenever the erroneous plan is selected. If actuated pedestrian movements are programmed, the coordinator shall ignore errors detected due to the pedestrian Walk and clearance times violating the phase split time for any actuated pedestrian. The controller must have a diagnostic screen that lists any of the NEMA TS 3.5, Section 2.5.11 status reasons for free mode operation and must also have a diagnostic status screen. The diagnostic screen shall include all relevant information about the failure that resulted in free mode operation. As an example, if the cycle length does not equal to the sum of the splits, then the indication would be cycle failure and the sum of the splits would be displayed.

The coordinator shall be programmable to seek offsets by short-way (lengthening or shortening the cycle lengths). Shortening will have a 0 to 25% entry and lengthening will allow for a 0 to 50% entry. The controller will also contain a dwell method of coordination which will allow the controller to stop at local cycle zero until the offset entry is satisfied. A dwell time entry will also be available which will limit the amount of time the controller stops at local zero.

The controller unit coordination program shall be designed to be programmed from the front panel to emulate the operation of a pretimed controller by recall for applications where no vehicle detection is provided.

In additional to the two NTCIP modes of coordination defined in NTCIP 1202, these seven (7) additional modes of coordination are required to be present in the controller:

1. Yield and force-off operation, in which each phase is provided a vehicle and pedestrian yield point and each phase is provided two force-off points.
2. Easy Coordination mode, which allows standard NTCIP auto modes, but the Yield points are calculated at a 6% increment for each phase following the coordinated phase.

3. N.J. mode, which allows a single permissive interval to yield to all phases from the coordinated phase.
4. Permissive fixed, which allows three (3) permissive periods to be defined, as well as a force-off for each phase.
5. Permissive floating, in which three (3) permissive periods can be defined and a split time is defined for each phase. The split time defines the maximum time a phase can have during that cycle.
6. Permissive fixed seconds, where the force-offs are defined in seconds.
7. Permissive floating seconds, where the split times are defined in seconds.

For each configuration, a coordinated phase must be selected from Ring 1. A coordinated phase must also be selected from other rings if a compatible phase with the Ring 1 coordinated phase exists. The coordinated phase, or phase pair, shall be selectable from one of the individual phases or phase pairs shown in this table:

CONFIGURATION				
Coordinated Phase(s)	8 Phase NEMA dual	Quad Sequential	8 Phase Sequential	4φ Diamond
Individual	--	4 or 8	2, 4, 6, or 8	
Pairs	2 & 6 or 4 &8	2 & 6	--	2 & 5, 4 &5, 1 & 6, or 1 & 8

If lead lag operation is selected, then during normal (8) phase operation only one phase needs to be selected as the coordinated phase. Compatible phase pairs shall not be forced to begin simultaneously.

When establishing its offset from the reference point for external coordination, the coordinator shall reference only the leading edge of the sync pulse, regardless of its width.

The internal coordination and upload/download programs shall not interfere with normal intersection operation except when changing ring structure in the controller or active phases. These operations (changing ring structure and active phases) shall require a confirmation and put the controller in a flash condition and a restart sequence. The implementation of revised timing parameters loaded into the timer shall be programmed to occur only at points in the controller coordination cycles which do not alter the controller phase sequence. The controller unit may temporarily drop out of synchronization during the upload/download, but must continue to operate.

g. **Time-Based Coordinator (TBC):** The TBC shall allow the features and operations specified under Time Of Day (T.O.D.) control.

The internal reference sync pulse, from which the local offset is calculated, shall resync at midnight, or the resync shall be user programmable with a default to midnight. A pulse shall be generated whenever the Time of Day Clock shows a time, which is an exact multiple of the current cycle length after this resynchronization. In case of a power failure, resync shall be calculated from the programmed resync time. The power failure recovery routine shall accommodate the case of a power failure at midnight.
An entry shall exist to change the reference by minutes from midnight.

h. **Communications Ports:** Each of the NEMA TS-2 specified ports shall have a selectable baud rate from 19.2 kilobaud, to 57.6 kilobaud.

i. **Coordination Control Hierarchy:** When the system switch is in the closed loop position, the controller unit shall be under the control of either the central computer, or an on-street master controller.

In the absence of any on line Closed Loop System control by a central computer, or on-street master controller, the internal TBC shall control the coordinated, free, and flash operation of the intersection.

When a master controller or central computer brings the intersection on line, its control shall supersede that of the internal time base coordination.

When the system switch is in the FREE position, the controller unit shall operate in a non-coordinated (free) mode.

j. **Preemption (PE):** The internal preemptor supplied shall be user programmable for priority preemption in the minimum sequences outlined in the following order: railroad (1 train sequence), emergency vehicle (4 high priority sequences), and bus/transit (4 low priority sequences). Each preemption sequence shall have separate timing intervals. A decoded input to the controller shall be provided to discriminate the priority level. A steady state low level input is defined as a high priority signal, and a pulsing low-level input is defined as a low priority signal.

Phases shall be selectable such that a limited signal sequence may be operational during preempt (PE). It shall be possible to add phases to this special limited sequence, which are not in the intersection sequence, without needing to add external logic.

The following intervals shall be provided as a minimum. While in preemption, the display will clearly identify the intervals being timed as preempt intervals. Yellow and red clearances from the phase timings may be utilized in place of the clearance intervals shown.

k. **Preemption Timing Interval Definition:** All intervals are sequential.
   1. PE Delay This time shall start immediately when the preempt command is received. It shall not affect the normal operation of the controller unit until the delay time out occurs. This interval may be used for emergency vehicle (fire lane) preemption delay. If 0 (zero) time is set, the interval shall be omitted.
   2. PE Minimum Duration - The preempt sequence shall not terminate until the preempt input signal is removed, and the Minimum Duration time has expired.
   3. PE Minimum Green Any vehicle signal that is Green at the time this interval becomes active shall not terminate unless it has been displayed for at least the time programmed in this interval. If 0 (zero) time is set, the interval shall be omitted.
   4. PE Minimum Walk - Preempt Minimum Walk Time in seconds. A preempt initiated transition shall not cause the termination of a Walk prior to its display for this period.
   5. PE Ped Clearance - At the time of pre-empt call, WALK indications shall immediately change to Pedestrian Clearance interval. The Pedestrian Clearance interval shall not terminate unless it has been displayed for at least the time programmed in this interval. If 0 (zero) time is set, the interval shall be omitted.

6. PE Track Green Signals programmed as track (or fire lane) signals shall remain Green or be changed to Green. All other signals shall be red. This interval shall be optionally programmable to zero during emergency vehicle PE.
7. PE Dwell Green - Minimum Dwell Time in seconds. This parameter controls the minimum timing for the dwell movement. The phase(s) allowed during the Dwell interval shall be selectable to include all phases that do not cross the track. The Dwell interval shall not terminate prior to the completion of Preempt Duration Time, Preempt Dwell Time, & the call is no longer present. Each signal shall be keyboard programmable for red, red flash, yellow flash or Green. As an alternative, a limited cycle shall be programmable for use with railroad preempts.
8. PE Exit Ped Clear - Preemption Exit Pedestrian Clear Time in seconds. This parameter controls the pedestrian clear timing for a Walk signal transition to the Exit Phase(s).
9. PE Exit Yellow - This interval shall provide a solid yellow clearance for indications that were green or flashing yellow. Red and flashing red displays shall display solid red.
10. PE Exit Red Clearance - This interval shall be an all-red clearance in preparation for return to the normal cycle. Return phases shall be programmable from the keyboard..
11. PE Max Call - This interval is the amount of time that a preempt call may remain active and be considered valid. When the preempt call has been active for this amount of time, the controller shall return to normal operation. The preempt call shall be considered invalid until the call is no longer active.

l. **Preempt Timing Interval Range:**

TIMING INTERVAL	TIME (Seconds)	INCREMENTS (Seconds)
0. PE Delay (Emergency vehicle preempt)	0-999	1
1. PE Minimum Duration	0-999	1
2. PE Minimum Green	0-255	1
3. PE Minimum Walk	0-255	1
4. PE Ped Clearance	0-255	1
5. PE Track Green	1-255	1
6. PE Dwell Green	0-255	1
7. PE Exit Ped Clear	0-255	1
8. PE Exit Yellow	3.0-25.5	0.1
9. PE Exit Red Clearance	0-25.5	0.1
10. PE Max Call	0-999	1

The phases to be serviced following the preempt sequence shall be front panel keyboard programmable.

Preempt sequences shall be selectable using external inputs. Preempt priority shall be assigned with #1 being the highest. If a higher priority preempt input is received during a preempt sequence, the controller unit shall immediately transition to the new sequence, subject to the constraints of PE Minimum Green and PE Minimum Walk. Provisions shall be made to clear two conflicting track phases from a single preempt input. This may be provided by two track clearance phases for a single preempt, or by combining two preempts.

Preempt 1 shall be reserved for a priority railroad preempt. If more than two preempts are provided, it shall be possible to delete the priority override for all but the railroad preempt. If a lower priority preempt is activated during another preempt cycle, the one in progress shall continue through its entire cycle. If the second preempt input is still active when the first one is

completed, the controller unit shall then initiate the low priority preempt. When all preempt inputs are removed, the controller unit shall proceed through the normal sequence to Return Red Clearance (Interval 9).

Once the controller unit has entered the first timed interval following Preempt Delay (Interval 1), the sequence shall continue to the end even if the preempt call is dropped. If the call returns and extends beyond the Minimum Preempt Duration (Interval 1), the controller should reinitiate track green and complete the preempt sequence.

The controller unit shall be programmable to be in flash, or in limited sequence, during interval 6. If flash is specified, the phases shall flash yellow or red, as user programmed. Flash shall be implemented by simultaneously flashing the appropriate load switch driver outputs. If limited sequence is selected, all phases shall be programmable, even if not normally used in the intersection sequence.

Should a preempt command be present, after power restoration following an electrical outage, the controller shall power up in cabinet flash operation and remain in such state until the PE command is removed.

Overlap phases shall begin and terminate with the parent phases, as described in NEMA TS 2. If the PE call occurs during yellow or red displays between parent phases, the overlap phase shall display a minimum of 3 seconds of yellow and a minimum of 1 second of red clearance.

Don't Walk shall be displayed throughout the preempt sequence unless a limited cycle is run. During a limited cycle (Interval 6), the pedestrian heads may be programmed to be dark.

Preempt routines shall have priority over all controller functions.

The controller shall be programmable to allow multiple track clearance phases either within a single preemption sequence, or by mapping multiple preempts together in all modes of operation.

The controller will have an entry that allows it to coordinate during limited sequence operation. When operating in this mode, the controller will perform a soft transition to the preemption return phases.

m. **Detection Control:** The controller shall have provisions for up to 64 combination vehicle or bicycle actuated input channels, when utilizing data Bus Interface Units (BIUs) within a NEMA TS-2 Type I standard cabinet, or up to 32 actuated input channels, without utilizing BIU=s, within a NEMA TS-1 standard cabinet. The controller shall allow user defined programmable mapping of the detector channels to reduce or eliminate the need to rewire a NEMA TS-1 standard cabinet in order to utilize all 32 detector channels.

All detection channels shall be capable of reporting volume and occupancy, at an interval of up to 99 minutes in one-second increments.

All detection channels shall be capable of reporting alarms based upon the following incidents, as prescribed by NTCIP 1202.

1. Maximum Presence, No Activity, Erratic Counts
2. When operating with BIUs: Open Loop, Shorted Loop, 25% Inductance Change,
3. Watchdog Fault

All detection channels shall be individually assignable to any phase, or unassigned. Assignment arrangement shall not alter the ability of any channel to collect data or report alarms.

All detection channels shall have the following features, as defined NTCIP 1202:

1. Call Phase Assignment
2. Switch Phase Assignment
3. Passage Detector Assignment
4. Queue Detector Operation
5. Delayed Detector Operation
6. Extended Detector Operation
7. Yellow Locking
8. Red Locking

All detection channels shall have the following enhanced features to govern both operation and data collection.

1. Delay Inhibit Phases
2. Occupancy on Green
3. Occupancy on Yellow

All features on all detection channels shall be capable of simultaneous operation. Features and their operation shall not be limited to a subset of detectors.

n. **Closed Loop Operation and Monitoring Software (CLS):** Multimedia gateway devices, necessary to operate the controller as a Closed Loop System secondary, shall be provided in the traffic signal controller cabinet when specified on the requisition. All necessary cables and communication ports needed for operation in a Closed Loop System cabinet shall be provided. The multimedia gateway equipment shall meet the same NEMA TS 2 environmental requirements as the controller.

The controller shall have internal software that allows the following functions and features.

1. Monitoring of signal indications, detectors, alarms, and time base functions.
2. Controller database error checking.
3. Coordination parameters.
4. Remote resetting of coordination errors.
5. Toggling special function outputs from the controller.
6. Allow the central system to receive reports and alarms generated from the controller.
7. Accommodate connection of multimedia gateway device to the controller to accomplish remote operation to the controller via the PC based software or direct connect vial laptop.
8. Controller must be able to inform System Operator of a stalled controller (CPU failure or output failure).
9. All capabilities and/or functions that can be programmed on the controller keyboard must also be capable of being accessed and downloaded via system computer.

The controller shall allow any of its detector inputs to be used with the system operation. The system shall report volume and occupancy counts based on a user-selectable time period for each detector. Storage of this data may take place at either the local or master controller, as specified within TS-3.4.

o. **Four (4) Phase and Three (3) Phase Diamond Operation:** Refer to Louisiana Department of Transportation and Development (LADOTD) Traffic Control Standard Number 18A for four (4) phase and three (3) phase diamond operations.

p. **Training:** The CONTRACTOR shall provide qualified instructors and all training material for training the LADOTD personnel in the operation and maintenance of system components. Training shall consist of classroom lectures as well as "hands on" training. Training shall be provided at no direct cost by the CONTRACTOR.

The CONTRACTOR shall develop and submit training course outlines and samples of all training aids and manuals to the DPW Chief Traffic Engineer for approval at least thirty (30) days prior to the proposed scheduled start of the training sessions. Written approval of this material shall be required prior to the final scheduling of the training sessions or the final productions of training materials. Training shall not begin until a minimum of two (2) weeks after approval of the submitted training material.

The CONTRACTOR shall develop and supply all necessary manuals, displays, class notes, and visual aids, and/or other instructional materials as required to provide the training programs described herein. The required manuals shall be individually bound in loose leaf binders and thirty (30) copies shall be provided.

All training sessions shall be conducted at locations in Baton Rouge, Louisiana. The training location shall be provided by the CONTRACTOR and approved by the DPW Chief Traffic Engineer. Dates and times of training shall be approved by the DPW Chief Traffic Engineer.

For all training programs, except the management program, a competent staff of engineers, technicians, and operations and maintenance personnel familiar with traffic signal and central operating hardware and software will be the training participants. Attendance will not exceed twenty-five (25) persons. The DTD Chief Traffic Engineer will determine the personnel who shall attend each training session.

Training sessions shall consist of a minimum of a total of eighty hours (80) hours for user orientation, theory of operation, and maintenance of equipment. Several training sessions may be held and shall not overlap.

1021-5.1.2 Signal Controller (ATC 32 Phase Rack Mount): This specification sets forth the minimum requirements for a rack mounted thirty-two-phase full-actuated traffic signal controller unit with internal Time-Based-Coordination (TBC), railroad/fire/transit emergency vehicle preemption, and closed loop secondary operation. The traffic signal controller unit shall fully comply with the latest publicized draft for NTCIP Object Definitions for Actuated Signal Controllers. All other specifications shall meet specification 1021.5.1.1 unless otherwise specified on the plans. This controller shall be CUBIC Commander Rack Mount controller or approved equal. This controller and software shall be compatible with existing traffic signal controllers in the EBR Traffic System.

1021-5.1.3 Signal Controller (ATC 32 Phase Shelf Mount): This specification sets forth the minimum requirements for a shelf mounted thirty-two-phase full-actuated traffic signal controller unit with internal Time-Based-Coordination (TBC), railroad/fire/transit emergency vehicle preemption, and closed loop secondary operation. The traffic signal controller unit shall fully comply with the latest publicized draft for NTCIP Object Definitions for Actuated Signal Controllers. All other specifications shall meet specification 1021.5.1.1 unless otherwise specified on the plans. This controller shall be CUBIC Commander Shelf Mount controller or approved equal. This controller and software shall be compatible with existing traffic signal controllers in the EBR Traffic System.

1021-5.2 Traffic Signal Controller Cabinet:

1021-5.2.1 TS-2 Traffic Signal Ground Mounted Cabinet:

a. **TS 2 Cabinet Assembly:** This specification describes the minimum acceptable requirements for a TS 2 cabinet assembly to house a 980 ATC solid state electronic microprocessor based fully actuated traffic signal controller unit. The assembly shall include the cabinet, flasher, card rack(s), an MMU, a Global Positioning System (GPS) unit, an external power supply, and six (6) flash transfer relays. The cabinet assembly shall include two (2), eight (8) position load switches. The Signal Controller pay item shall include all cabinet equipment/items required to accommodate: fiber tie in, specified detection and PTZ surveillance cameras, as needed and specified on the plans.

   Contractor shall submit product submittal to the Traffic Engineer Division for approval prior to ordering equipment.

b. **Cabinet Design Requirements:** The cabinet shall be constructed using unpainted sheet aluminum with a minimum thickness of one eighth inch (1/8”). No wood, wood fiber products, or other flammable material shall be used in the cabinet. All welds shall be neat and of uniform consistency.

   The configuration of the cabinet shall be a single door (with extension) base mount TS 2 size 6E cabinet as defined by TS 2 Clause 7.3 of the NEMA Standard Publication TS 2-1992.

   Two (2) aluminum lifting eyes or ears shall be attached to the cabinet with a single carriage bolt each to permit lifting the cabinet with a sling. The corners of each eye or ear shall be rounded and in the down position when shipped.

   Vertical shelf support channels shall be provided to permit adjustment of the shelf location in the field. The channels shall have a single continuous slot to allow shelves to be placed at any height within the cabinet. Channels with fixed notches or holes are not acceptable.

   Each cabinet shall be equipped with an extra set of Unistrut channels or a keyhole panel on either side of the front section of the cabinet to permit the purchaser to mount additional equipment as necessary.

   Shelves shall be at least thirteen (13) inches deep and be located in the cabinet to provide a one-half inch (1/2”) clearance between the back of the shelf and the back of the cabinet. A one and one-half inch (1 ½”) deep drawer shall be provided in the cabinet, mounted directly beneath the controller support shelf. The drawer shall support up to fifty (50) pounds in weight when fully extended. The drawer shall open and close smoothly. Drawer dimensions shall make maximum use of available depth offered by the controller shelf and be a minimum of twenty-four (24) inches wide.

   Two (2) shelves shall be provided in the cabinet and shall be at minimum twelve (12) inches apart in height. There shall be sufficient shelf space to accommodate a controller unit thirteen (13) inches high, an MMU, one eight (8) position card rack and external power supply. An additional space at least thirteen (13) inches high, fourteen (14) inches wide, and twelve (12) inches deep shall be provided. The controller unit, MMU, card racks, and power supply shall be placed on the shelves in such a manner that sufficient ventilation is provided to all components. Labels showing the proper placement of each component shall be provided along the shelves to ensure proper placement.

The cabinet shall be vented and cooled by two (2) separate thermostatically controlled fans. The fans shall be a commercially available model with a capacity of at least one hundred (100) cubic feet per minute. The thermostats shall be adjustable range of seventy (70) degrees to one hundred and sixty-five (165) degrees Fahrenheit (°F) each. A press-to-test switch shall be provided to test the operation of the fans.

The cabinet shall be provided with a unique five-digit serial number which shall be stamped directly on the cabinet or engraved on a metal or metalized mylar plate, epoxied or riveted with aluminum rivets to the cabinet. The digits shall be at least two tenths (0.2) inch in height and located on the upper right sidewall of the cabinet near the front door.

c. **Cabinet Door:** The cabinet shall be provided with one (1) door in front that will provide access to the cabinet. The door shall be provided with three (3) hinges with non-removable stainless steel pins, or a full-length piano hinge with stainless steel pins spot welded at the top of the hinge. The hinges shall be mounted so that it is not possible to remove them from the door or cabinet without first opening the door. The bottom of the door opening shall extend at least to the bottom level of the back panel. The door and hinges shall be braced to withstand a fifty (50) pound per vertical foot of door height load applied to the outer edge of the door standing open. There shall be no permanent deformation or impairment of any of the door or the cabinet body when the load is removed.

The cabinet door shall be fitted with a Number 1 Corbin lock and a stainless steel handle with a five-eighths inch (5/8") (minimum) diameter shaft (or equivalent cross-sectional area for square shaft) and a three (3) point latch. The lock and latch design shall be such that the handle cannot be released until the lock is released. Two (2) keys shall be provided for each cabinet. A gasket shall be provided to act as a permanent dust and weather resistant seal at the controller cabinet door facing. The gasket material shall be of a nonabsorbent material and shall maintain its resiliency after long term exposure to the outdoor environment. The gasket shall have a minimum thickness of three eighths inch (3/8"). The gasket shall be located in a channel provided on the cabinet or on the door(s). An "L" bracket is acceptable in lieu of this channel if the gasket is fitted snugly against the bracket to ensure a uniform dust and weather resistant seal around the entire door facing. Any other method is subject to purchaser approval during inspection of an order. The door shall have a stopping mechanism located on the inside top right corner of the cabinet opening. The attachment should allow for a ninety (90) degree opening, a one hundred thirty-five (135) degree opening and one hundred eighty (180) degree opening. The door rest shall be straight to prevent door movement in windy conditions.

A locking auxiliary police door shall be provided in the door of cabinet to provide access to a panel that shall contain a signal shutdown switch, a signal flash switch, a manual-automatic switch, and manual advance push-button switch on a six (6) foot retractable cord. Manual control of the controller unit from the police door shall override any external control (external logic, etc.) in effect when the Manual-Automatic switch is in the manual position. Each actuation of the manual advance push-button switch shall be gasketed to prevent entry of moisture or dust and the lock shall be provided with one (1) brass key.

The intake for the vent system shall be filtered with a replaceable air filter. The minimum filter dimensions shall be sixteen inches (16") wide by twelve inches (12") high by one inch (1") thick. The filter shall be securely mounted so that any air entering the cabinet must pass through the filter. The cabinet opening for intake of air shall be large enough to use the entire filter. The air intake and exhaust vent shall be screened to prevent entry of insects. The screen shall have an opening no larger than one hundred and twenty-five thousandths (0.0125) square inch. The total free air opening of the exhaust vent shall be large enough to prevent excessive backpressure

on the fan.

d. **Wiring:** All wiring within the cabinet shall be neat and routed such that opening and closing the door or raising or lowering the back panel will not twist or crimp the wiring. All wiring harnesses shall be either braided, sheathed in nylon mesh sleeving, or made of polyvinyl chloride (PVC) or polyethylene chloride (PEC) insulated jacketed cable. Wiring leading to the cabinet door shall be sheathed in nylon mesh sleeving or be PVC jacketed cable only. All SDLC cabling shall be Belden #7203A or equivalent size.

All conductors between the main power circuit breakers and the signal power bus shall be a minimum size of 10 AWG stranded copper. All conductors carrying individual signal lamp current shall be a minimum size of 16 AWG stranded copper. All AC service lines shall be of sufficient size to carry the maximum current of the circuit or circuits they are provided for. Minimum cabinet conductor wire size shall be 22 AWG stranded copper. All wiring and insulation shall be rated for 600 V or greater.

No P.C. boards will be allowed on the back panel of the cabinet. All wiring must be done from the BIUs to the Load Switches using standard 19-gauge wiring.

A barrier terminal block with a minimum of three (3) compression fitting terminals designed to accept up to a # 4 AWG stranded wire shall be provided for connection of the AC power lines. The block shall be rated at minimum fifty (50A) Amperes.

All terminals shall be permanently identified in accordance with the cabinet wiring diagram using an anodized silk screening process on the aluminum panel. Where through-panel solder lugs or other suitable connectors are used, both sides of the panel shall have the terminals properly identified.

Identification shall be placed as close to the terminal strip as possible. Each controller input and output function shall be distinctly identified with no obstructions, at each terminal point in the cabinet, with both a number and the function designation. The same identification must be used consistently on the cabinet wiring diagrams.

Each load switch socket shall be identified by phase number, overlap number, and pedestrian phase number as applicable. No cabinet equipment, including the load switches themselves, may obstruct these identifications. Each flash transfer base and power relay base shall be properly identified with no possible obstructions.

Each harness within the cabinet shall be distinctly identified by function on the connector end. The flasher socket shall be distinctly identified with no possible obstruction. All other sockets needed within the cabinet to fulfill the minimum requirements of the Invitation to Bid, or attachments thereof, shall be distinctly identified.

The controller unit harness (A plug) shall be long enough to reach any point sixteen (16) inches above the timer shelf. The conflict monitor harness and any required auxiliary harness shall reach twenty four (24) inches from the conflict monitor shelf.

Copper ground buses shall be provided for both the power supply neutral (common) and chassis ground. Each bus bar must provide a minimum of ten (10) unused terminals with 8-32” x 5/16” or larger screws. The AC neutral and chassis ground buses shall be jumped together with a minimum # 6 AWG wire.

The AC+ power shall have one input and shall be bused to five (5) separate circuits. The

breakers shall be a single pole, molded case, screw mounted on this panel with two (2) #10 screws on a four and one-half inch (4 ½") pattern. Each breaker shall indicate visually that the breaker has been tripped. Each breaker shall indicate visually that the following are the functions and labels for each breaker:

Main power (CB1) – ON/OFF – this shall be rated for sixty (60) amps and control the AC+ power into the cabinet for all equipment. The power for the auxiliary circuits shall be controlled by this switch. (filtered)

Auxiliary Power (CB2) – ON/OFF – this shall be rated for twenty (20) amps and control the AC+ power to the ventilation fan, LED cabinet light, and convenience outlet (bottom right side) of the cabinet. (filtered).

Controller power (CB3) – ON/OFF – this shall be rated for ten (10) amps and control the AC+ power to the controller and conflict monitor. (filtered and suppressed).

Detector Panel Power (CB4) – ON/OFF – this shall be rated for ten (10) amps and control the AC+ power to the loop detector panel used for interconnect relay outputs. This circuit shall not be used for detector card rack and shall not be connected to the suppressor on the power panel.

Communications Power (CB5) – ON/OFF – this shall be rated for thirty (30) amps and controls the top left rear power outlet. (filtered and suppressed)

The Power Panel Isolation shall consist of a clear, non-breakable, one-fourth inch (1/4") Lexan insulating cover to shield all open connections and not cover any switch, breaker levers or convenience outlet. The cover shall be secured in place with screw fasteners and be removable by hand or simple hand tools. The convenience outlet (bottom right) shall be a feed through, ground fault interrupter type, twenty (20) amps (Auxiliary Power). The receptacle shall have three (3) wires from the device to the appropriate terminal on the power panel, (Ground, AC-, and AC+).

The circuit breaker shall be equipped with solderless connectors and installed on the right-side wall (facing the cabinet) or lower right hand side of the back panel inside the cabinet. The breakers shall be easily accessible. The breakers shall be positioned so that the rating markings are visible.

A Ground Fault Circuit Interruption (GFCI) type duplex receptacle shall be mounted and wired in the lower right-side wall of the cabinet.

The above breakers are in addition to any auxiliary fuses which may be furnished with the controller to protect component parts, such as transformers, etc.

The load side of the main circuit breaker shall be protected by a two (2) stage lightening surge suppresser, equivalent to the EDCO APC340 (with LED indication along with a set dry contacts for alarm capabilities to indicate proper operation). The suppresser ground connection shall be connected to the cabinet by means of a short, heavy copper ground strap. The strap shall be bonded to the cabinet.

The suppresser shall be connected to the line filter as recommended by the manufacturer. Number 10 AWG or larger wire shall be used for connections to the suppresser, line filter and load switch bus.

LED lighting, with switch, shall be installed in the cabinet. These lights shall be turned on when

the cabinet door is opened and turn off when the cabinet door is closed via a door switch. An MOV or other such transient suppression device shall be placed across the AC power input to the LED lights.

A radio frequency interference (RFI) suppresser shall be provided and installed on the load side of the signal circuit breaker and shall be protected by the surge protector. This filter shall be rated at fifty (50) amps and shall provide a minimum attenuation of fifty (50) decibels over the frequency range of 200 Kilohertz to 75 Megahertz.

Transient suppression devices shall be placed on the coil side of all relays in the cabinet. DC relay coils shall have, as a minimum, a reversed biased diode across the coil. AC relays shall have MOV's or equivalent suppression across their coils. RC networks are acceptable. One (1) suppression device shall be supplied for each relay.

Except where soldered, all wires shall be provided with lugs or other approved terminal fittings for attachment to binding posts. Insulation parts and wire insulation shall be insulated for minimum of six hundred (600) volts.

The outgoing traffic control signal circuits shall be of the same polarity as the line side of the power source.

A switch shall be mounted on the right side of the cabinet near the power supply area and shall be labeled Test-Normal. When the switch is in the Normal position, call for flashing operation shall remove the power from the controller unit. When the switch is in the Test position, the call for flashing operation shall permit the controller unit to continue to run so that its operation can be observed.

A switch shall be provided near the Test-Normal switch to cause the controller unit, and any auxiliary equipment, to stop timing. It shall be labeled "STOP TIMING".

The cabinet shall be wired so that activation of the MMU will cause the controller unit, and any auxiliary equipment, to stop timing.

Conflict and manual flash shall be wired for all red.

The cabinet shall be designed and equipped with enough transfer relays to change any main street indications (movements 2, 6, and/or 1, 5) to amber for the conflict and/or manual flash operation on the face of the back panel or a side panel, using only simple tools.

Transfer relays shall be the plug-in type manufactured by Midtex (Part No. 136-62T3A1) or AEMCO (Part No. 136-4992), or equivalent. The relays shall have contacts a minimum of three eighths (3/8) inch diameter in size and shall be rated at a minimum of thirty (30) amps 120/240 VAC, twenty (20) amps 28 VDC.

The red enable and remote reset from the conflict monitor shall be terminated on the face of the back panel.

A seventy-five (75) amp, solid state relay shall be wired between the RFI filter output and the load switch power bus. The relay shall be controlled by the signal shutdown switch and the flash switch. The relay shall be mounted to a heat sink designed to allow maximum current flow at +74 C without damaging the relay.
All exposed AC wiring points, including the RFI filter, surge suppresser, and solid-state relay shall be covered with a clear non-conductive plastic cover to prevent accidental contact. Unless

otherwise noted in this specification, wiring at terminal strips is exempt from this requirement.

An input point shall be provided on the back panel to allow external reset of the Malfunction Monitoring Unit.

The load switch outputs shall be brought out through posted 10-32" x 5/16" binder head screw terminals. Field wiring for signal heads shall be connected at this terminal strip and shall be color coded to the appropriate signal indication.

e. **Detector Panel and Card Rack:** The cabinet shall have a loop detector panel mounted on the left side of the cabinet. This panel shall provide for all connections between loops at the street and the detector amplifiers as described in the following sections.

f. **Detector Card Rack:** The card rack for cabinet configurations one (4 position), two (8 position), and three (12 position backpanel) shall be TS 2 detector rack and shall accommodate two (2) – four (4) channel TS 2 detector units. Two (2) card racks, one (1) TS 2 detector rack configuration one (1) and one (1x) TS 2 detector rack configuration two (2), shall be provided for cabinet configuration four (4) (16 position backpanel) and shall accommodate up to six (6) - four (4) channel TS 2 detector units.

The detector card rack shall have a rigid frame and shall be fabricated from aluminum and shall have slots set in a modular fashion such that the PCB edge connectors shall plug into the rear while sliding between top and bottom card guides for each module. Mounting flanges shall be provided and be turned outward for ease of access. The detector card rack shall be bolted to a cabinet shelf. It shall be possible to unbolt the rack using simple tools.

All wiring to the rack shall be labeled and color coded and neatly run to other parts of the cabinet and detector termination panel including the emergency vehicle detector rack and the pre amp panel.

The slots shall be numbered one (1) to eight (8) left to right when viewed from the front of the rack. A flange shall be provided on the top and the bottom of the rack to label each individual channel.

The Detector DC Supply shall be bused to a common point and wired to the Intersection Detector Panel.

The Chassis Ground shall be bused to a common point and wired to the Detector Panel.

The Logic Ground shall be bused to a common point and wired to the Detector Panel.

The Data Address for the detector channels shall be according to TS 2.

g. **Detector Panel:** The Detector Panel shall provide all connections between the detector loops and the detector amplifiers.

The panel shall be constructed of one eighth inch (1/8") aluminum.

The panel shall contain a three inch (3") horizontal slot in each corner to accommodate one fourth inch (1/4") mounting bolts.

All inputs from the loops shall be brought through posted 10-32" x 5/16" binder screw terminals

or 8-32” x 5/16” binder screw terminals.

Each loop pair shall be protected by lightning surge suppresser. The suppressers must be mounted behind the panel using feed through screw terminals to attach the suppressers.

Each detector will have a test switch such that when the switch is closed, a call is placed upon that detector input. The test switch will have three (3) positions; no effect, permanently on, and momentarily on.

The detector panel for cabinet configurations one (#1) (4 position), two (#2) (8 position), and three (#3) (12 position) shall provide the following connection points as a minimum for sixteen (16) detectors:

CONNECTION POINT	NO. OF CONNECTION POINTS
EXTERNAL 24V POWER SUPPLY	1
LOOP INPUTS	32, 2 FOR EACH DETECTOR
LOGIC GROUND	1
SPARES	6
CHASSIS GROUND BUS	1 BUS

The detector panel for cabinet configuration four (#4) (16) position shall provide the following points as a minimum for twenty-four (24) detectors:

CONNECTION POINT	NO. OF CONNECTION POINTS
EXTERNAL 24V POWER SUPPLY	1
LOOP INPUTS	24, 2 FOR EACH DETECTOR
LOGIC GROUND	1
SPARES	0
CHASSIS GROUND BUS	1 BUS

A chassis ground bus bar shall be provided on the panel and connected to the cabinet by an insulated braided copper ground strap. The strap shall be bonded to the cabinet.

h. **Preempt/Communication Panel:** A preempt/communication panel shall be provided that contains all interface circuits and wiring for preemption and communication functions. The panel shall be located on the left side of the cabinet interior. The entire panel shall be labeled to identify each pre amp (i.e. 2,3,4,5 etc.) as well as emergency vehicle detection, etc.

Three (3) input relay circuits, with 120 VAC coil and contacts rated for the application, shall be provided on the preempt panel. These circuits shall be used to isolate the incoming preempt commands from the controller unit logic circuitry. The circuits shall be programmable to operate with either a normally open or normally closed relay contact by jumpers on a terminal strip. A barrier strip protected from accidental contact by service personnel shall be supplied to connect the external input. It shall be possible to use either a neutral or hot 120 VAC input. Relays used shall be plug-in Potter Brumfield K10P series/Manecraft W-78 series or interchangeable equivalent. The relays shall be mounted in relay sockets.

Adequate protection of the input relay circuits as well as the preemptor circuitry shall be provided to eliminate damage or false preemption commands caused by line transients or lightning surges. The devices shall have a minimum rating of twenty (20) Joules.

Three (3) momentary test switches, one (1) for each preempt circuit, shall be provided on the preempt panel. The operator shall not be exposed to hazardous voltages during operation of the

test switches.

All necessary interconnection cables and mounting hardware shall be provided.

There shall be a switch on the preempt/communication panel, which shall release the local controller to operate in an isolated, full-actuated manner, when necessary for maintenance purposes. The switch positions shall be labeled “SYSTEM” and “FREE”.

Terminal connections for three (3) twisted pair communication lines and one (1) telephone line shall also be provided. The protection will consist of series twenty-five (25Ω) ohm resistors, fifteen (15) volt transorbs, and other devices, which allow protection including primary overvoltage protection, resettable overcurrent protection, secondary clamping voltage protection, and fast transient filtering. The secondary overvoltage stage shall allow peak voltages of no more than 250 volts. The fast transient filtering stage shall provide no less than forty (40) dB/decade of attenuation to transients above the required pass band. The protection shall be provided in an integrated closure with eight (8) input/output terminations and ground connection.

i. **Power Supply:** The power supply shall be a shelf mounted, enclosed, twenty-four (24) VDC power supply in accordance to Clause 5.3.5 of the NEMA Standards Publication TS 2-1992.

One (1) power supply cable per power supply shall be furnished and installed in each cabinet. The wires shall be terminated to bus bars, terminals on the front of the backpanel, detector panels, or connector as appropriate. The connections shall be with forked spade lugs or otherwise as needed. Each individual wire shall be cut to the length required to reach the point at which it is to be connected.

j. **Two Circuit Solid State Flasher:** The solid state, two (2) circuit flasher shall meet the electrical and physical characteristics described in Clause 6.3 of the latest NEMA Standards Publication TS 2. The flasher shall be Type III (dual circuit rated at fifteen (15) Amps per circuit) unit and so constructed that each component may be readily replaced if needed.

The two (2) circuit flasher shall be of solid-state design and contain no electro-mechanical devices.

k. **Load Switch:** The solid-state load switches shall meet the requirements set forth in Clause 6.2 of the latest NEMA Standards Publication TS 2, and shall be “Triple-Signal Load Switch” type.

And indicator light for each circuit shall be provided in each load switch. The indicator light shall be on when a “Low Voltage Active” input to the load switch is present.

l. **Malfunction Management Unit (MMU):** This specification sets forth the minimum requirements for a shelf-mountable, sixteen (16) channel, solid state Malfunction Management Unit (MMU). The MMU shall meet, as a minimum, Section 4 of the NEMA Standards Publication TS 2-1998. Where differences occur, this specification shall govern.

No circuit cuts shall be allowed on circuit boards in any of the equipment supplied. Any wire jumpers included on circuit boards shall be placed in plated through holes that are specifically designed to contain them. Jumpers that are tack soldered to circuit traces or are added to correct board layout errors are not acceptable.

All IC's with sixteen (16) or more pins shall be mounted in machine tooled sockets. All sockets shall have two-piece, machined contacts and closed end construction to eliminate solder wicking. The outer sleeve shall be brass with tin or gold plating and tapered to allow easy IC insertion. The inner contact shall be beryllium copper subplated with nickel and plated with gold. All sockets shall have thermoplastic bodies meeting UL Specification 94V-0. Other high-quality sockets may be acceptable but must have prior approval of the Traffic Engineering Division. Sockets meeting alternate specifications shall be submitted in writing with the bids. Zero insertion force sockets will not be allowed.

The design shall allow for removal or replacement of a circuit board without unplugging or removing other circuit boards.

The unit shall be designed so that one side of each board can be completely accessible for troubleshooting and testing the unit while it is still operating. This may be accomplished with extender boards or cables. This need apply to only one circuit board at a time.

Each channel shall contain a RED, YELLOW and GREEN led representative of the active color of each channel during operation.

No more than two (2) circuit boards shall be attached to each other to constitute a circuit assembly. Attaching hardware shall use captive nuts or other acceptable method to secure the boards together. Alternate methods shall be submitted in writing with the bids. The boards shall be designed so that the purchaser can test and operate the controller unit with the boards separated.

If this specification is used to support the purchase of a complete controller assembly, the unused red circuits shall be connected to the AC Line in the controller cabinet.

The MMU shall have on the front panel, an RS232 Port, an Ethernet Port, and a programming keyboard, as well as a sixteen (16) column by four (4) line LCD Display.

The MMU shall provide for unused yellow inputs to be remapped for a fourth input to other channels as needed.

Each Malfunction Monitoring Unit shall have a unique serial number that is permanently and neatly displayed on the face of the unit. If this serial number is not on the face of the unit, then an additional temporary label that is neatly printed or typed shall be affixed to the MMU face.

m. **Global Positioning System (GPS) Unit:** The cabinet shall be equipped with a GPS unit that will continuously update the time clock within the traffic controller. This unit shall be installed using a gasket and sealant as to not allow any water intrusion into the cabinet.

1021-5.2.2 TS-2 Traffic Signal Pole Mounted Cabinet: The TS-2 cabinet assembly shall be able to house a NEMA TS-2, Type 1 or 2 controller unit. At a minimum, the assembly shall be a fully loaded cabinet and include, the cabinet, three (3) BIU's, flasher, Standard TS-2 detector card rack(s) 4-channel dominant, one (1) 4-channel loop amplifier card, an MMU, a 24-volt external power supply, and six (6) flash transfer relays. The pole mounted cabinet shall be configuration 3 (12 position), the assembly shall include twelve (12) load switches.

The cabinet exterior shall be constructed using unpainted sheet or cast aluminum alloy with a minimum thickness of 0.125" (3.2mm). The aluminum alloy shall be ASTM No. 5052-H32 or equivalent. No wood, wood fiber products or other flammable mate1ial shall be used in the cabinet. All welds shall be neat and of uniform consistency.

The cabinet interior, including shelves, shall be powder coated white in color.
Cabinets shall be manufactured to prevent accumulation of water on its top surface and slope in a manner to drain water to the back side of the cabinet.

Cabinet Shell dimensions shall be as follows, unless otherwise approved by East Baton Rouge (EBR) Traffic Engineering Division:

Height	Width	Depth
60”-70”	22”-36”	15”-17”

1021.5.2.3 ATC Shelf Mount Traffic Signal Ground Mounted Cabinet: The ATC Shelf Mount Traffic Signal Ground Mounted Cabinet shall be compatible with the ATC 32 Phase Shelf Mount Controller. The cabinet base shall fit on the controller cabinet base shown on EBR City Standard Detail Sheet 906-03 Electrical Details (Controller Cabinet) Sheet 2 of 5. All new traffic signal cabinets shall ensure that the new traffic signal controllers are compatible with the existing EBR Traffic System.

1021.5.2.4 ATC Rack Mount Traffic Signal Ground Mounted Cabinet: The ATC Rack Mount Traffic Signal Ground Mounted Cabinet shall be compatible with the ATC 32 Phase Shelf Mount Controller. The cabinet base shall fit on the controller cabinet base shown on EBR City Standard Detail Sheet 906-03 Electrical Details (Controller Cabinet) Sheet 2 of 5. All new traffic signal cabinets shall ensure that the new traffic signal controllers are compatible with the existing EBR Traffic System.

1021-5.3 Traffic Signal Cabinet Battery Back-Up:

a. **General**: This specification establishes the minimum requirements for a complete emergency battery back-up system for use at traffic signals. The BBS shall provide reliable emergency power to a traffic signal in the event of a power failure or interruption.

   The Battery Back-up System (BBS) shall include, but not be limited to the following:
   1. UPS with Inverter, Charger, Tap Switching Transformer and Internal Power Transfer Switch.
   2. Automatic / Manual Bypass Transfer Switch unit.
   3. Batteries
   4. Cabinet
   5. Mounting hardware
   6. Wiring

b. **Operation:** The BBS shall provide the following operational modes when operating on battery power:
   1. Full operation of all traffic signal and communications devices
   2. Flash operation
   3. Combination of full and flash operation

   The BBS shall provide a minimum of four (4) hours of full-time operation. Wattages will be provided on a per location basis but will be a minimum of 500 Watt load.

   The BBS shall be compatible with any NEMA style cabinet and enclosures; the advanced transportation controller; and all cabinet components for full time operation.

   When operating in backup mode, The BBS output shall be 120VAC ± 2%, pure sine wave output, ≤3%THD, 60Hz ± 0.3 Hz.
   The BBS DC system voltage shall be 48VDC nominal.

The maximum transfer time allowed, from disruption of normal utility line voltage to stabilized inverter line voltage from batteries, shall be five (5) milliseconds (ms). The same maximum allowable time shall also apply when switching from the inverter line voltage to utility-line voltage. Transfers to and from battery operation shall not interfere with the continual operation of the field traffic control and communications equipment.

The BBS and all components shall operate without performance degradation over a temperature range of -40°F to +165°F with a maximum load of 70% of rated output of the BBS inverter.

The BBS shall be tested and certified to Electrical Standards UL 1778 and CSA 107.3.

The BBS shall have surge protection compliant with IEEE/ANSI C.62.41 Cat. A & B.

The BBS system shall have a Mean-Time-Before-Failure (MTBF) of 174,955 hours at a temperature of 25 degree C (77 degree F) and 103,030 hours at a temperature of 50 degree C (122 degree F).

The BBS shall be easily installed, replaced, or removed by using easily removable cables for AC input, AC output, DC input, external transfer control/alarm and battery temperature sense.

i. **AC Connection:** The AC input and output shall hard wired connections.
ii. **DC Connection:** The DC connection shall be a recessed one-piece Anderson Style connector rated to handle the maximum DC current required by the inverter while running on batteries.
iii. **Temperature Probe Connections:** The battery temperature sense inputs shall be panel-mounted Telco style connector.

In the event of inverter/charger failure, battery failure or complete battery discharge, the automatic bypass transfer switch shall revert to Normally Closed (NC) (de-energized) state, where utility line power is connected to the cabinet.

The BBS Inverter Module must be able to shut down to protect against internal damage in the event of an overload at the output. The Inverter shall support an overload up to 115% for 2 minutes and then turn off the inverter output. The fault recovers when the overload is removed and line power returns.

The BBS shall provide two (2) time-of-day schedule settings programmable by the user. The time-of-day schedule shall allow the user to program schedule operational modes as required, per intersection.

The BBS time-of-day function when programmed shall automatically change operational modes based on the time-of-day schedule. Operational modes shall be Red Flash or Full Operation.

The BBS shall not switch from Flash Operation to Full Operation mode when the remaining battery capacity is ≤40 percent.

The BBS shall prevent a malfunction feedback to the cabinet or from feeding back to the utility service.

In the event of BBS failure (inverter/charger or battery) or complete battery discharge, the internal power transfer relay shall revert to Normally Closed (de-energized) state and provide utility power to the intersection when utility line power is available to the cabinet.

The BBS shall initiate an automatic shutdown when battery output reaches 42.5VDC.

The BBS shall be equipped with an integral system to prevent the battery from destructive discharge or overcharge.

c. **Automatic Bypass Transfer Switch:** The BBS shall include an Automatic/Manual Transfer Switch rated at 120VAC and a minimum of 30 amps.

The Automatic Bypass Transfer Switch shall be a combination automatic/manual bypass switch. Placing the bypass switch in the "Bypass" mode shall transfer the intersection load from the UPS output directly to commercial power. AC commercial power must still be available to the UPS input, allowing the UPS to keep the batteries charged. An Inverter Input breaker shall be provided and located on the Bypass Switch so to shut off commercial power to the UPS input, allowing safely disconnecting and removing the inverter. With the inverter turned off, the batteries can be safely disconnected from the system.

The Automatic Bypass Transfer Switch shall include a bypass indicator light that automatically notifies the user when the Manual bypass switch is in Bypass position. The indicator light shall be illuminated when in UPS mode.

The Automatic Transfer Switch shall have an optional bypass status relay with normally open, dry contacts that automatically close when the Manual bypass switch is in Bypass position.

The manual bypass switch and the automatic transfer relay shall be integrated together within the Automatic Bypass Transfer Switch allowing the manual bypass switch to be rated at fifteen (15) Amp and to be integrated with the bypass indicator light.

The Automatic Bypass Transfer Switch shall have terminal blocks capable of accepting #6 AWG wiring for the AC input and output with #10 AWG from the Automatic Bypass Transfer Switch to inverter/charger module.

d. **Functionality:** The BBS shall include AVR (Auto Voltage Regulation) functionality.

i. **AC Input Voltage Range for Output Regulation:** The Buck/Boost mode shall have a minimum range of 88 - 175 VAC
ii. **Transfer Set Points:** There shall not be any user definable transfer set points for the buck boost mode.
iii. **Regulated Voltage:** Whenever AVR mode is selected the output of the system shall be regulated between 108-130 VAC. When the output of the system can no longer be maintained with this range, the BBS shall transfer to Backup Mode.

The BBS shall be equipped with an AC Input circuit breaker that protects both the UPS and the loads connected to the output. Should the AC Input breaker on the UPS trip, it shall allow the UPS to go to inverter mode to power the intersection off of batteries. Should an overload condition still exist when the inverter is energized, the inverter will revert to its internal electronic protection, preventing damage to the inverter due to the overload or short circuit condition, on the output. Once this overload condition is cleared, the inverter will energize and power the intersection utilizing the available battery power. If the condition does not clear itself, the inverter will stay in the standby mode until manually cleared by a technician.

The BBS shall have a flush mounted battery circuit breaker installed on the front panel of the BBS inverter module.

The BBS shall have a user definable line qualify time. The user shall be able to select a minimum of six (6) possible settings. The settings shall be 3, 10, 20, 30, 40 and 50 seconds.

The BBS shall have an integral charger that is compatible with Gel and AGM battery topology. The charger shall be an intelligent charger with control systems that automatically incorporates bulk, absorption and float charging modes.

The integral intelligent charger shall use temperature compensation. The charging system shall compensate over a range of 2.5 - 6.0mV/°C per cell, user adjustable, when required.

A temperature probe which plugs into the front panel of the BBS shall be used to monitor the internal temperature of the batteries. The temperature probe shall be six (6) feet in length, external to the inverter/charger module and taped to the side of a center battery within the battery string.

The batteries shall not be recharged whenever the battery temperature exceeds 50°C.

The recharge time for the batteries from "protective low-cutoff" to 90 percent or more of full charge capacity shall not exceed twelve (12) hours. The BBS charger shall be capable of providing fifteen (15) amps at 54VDC.

e. **User Interfaces and Displays:** The BBS inverter/charger unit shall include a backlit LCD display for viewing all status and configuration information. The screen shall be easily viewable in both bright sunlight and in darkness.

The screen shall be large enough to display the following information with the use of menu scrolling buttons to read required information. All active readings shall be real time.

1. Operating Mode (Line, Standby, Backup, Buck / Boost)
2. Utility input voltage
3. BBS output voltage and current
4. Battery Temperature
5. Input Frequency
6. Output Power
7. Battery Voltage
8. Charger Current
9. Shed Timer Relays time to activation
10. Ethernet MAC Address and IP Address
11. Accumulated output power in kW hours
12. Battery Runtime Remaining
13. Unit Serial number
14. Unit Firmware Version
15. Any alarms and faults

The BBS inverter/charger unit shall include a keypad for navigating system information.

The BBS shall be provided with a web-based-interface for user configuration and management through a web browser.

The BBS shall allow the user to do the following through the web browser

1. View Logs
2. Change modes of operation
3. Configure email alarms
4. Adjust line qualify time

5. Program relay contacts
6. Configure network parameters.
7. Inverter/charger firmware to be upgradeable remotely via Ethernet.
8. Communication module firmware upgradeable remotely.

The BBS shall have discrete status LED indications on the front of the inverter/charger.

This LED will be ON any time that the output of the BBS is in normal mode. When the BBS output is either in Backup Mode or AVR Modes the LED will flash On and Off.

This LED will be Solid On any time that there are any faults in the system

This LED will Flash On and Off any time that there are any alarms in the system.

The BBS shall maintain an event log containing a minimum of 200 of the most recent events recorded by the BBS. These events shall be downloadable remotely via Ethernet and automatically reported to the central monitoring software. The Events Log shall be date and time stamped.

The BBS shall display and log the following events, alarms, and faults.
1. Operating Mode
2. Weak Battery
3. Overload
4. High and Low Temperatures
5. User Input, S2 is shorted
6. Line Frequency out of specifications
7. No temperature probe
8. Low Battery
9. Battery Breaker Open
10. BBS is performing a Self-Test
11. Fan Fail
12. Incorrect Firmware
13. AC Input Breaker Open
14. Short Circuit
15. Output Voltage High
16. Output Voltage Low
17. Battery Voltage High
18. Battery Voltage Low
19. Isolation Relay Fail
20. Temperature High

The BBS shall keep track of the following:
1. The number of times that the unit was in Backup Mode
2. The accumulated number of hours and minutes that the unit has operated in Backup mode since the last reset.

The BBS shall provide the user with a minimum of five (5) programmable dry relay contacts and one (1) 48VDC relay contact. As a minimum, the programmable options shall be On Battery, Low Battery, Timer, Alarm, Fault, and Off. The BBS shall also have three (3) input dry relay contacts. BBS Self-Test, User Alarm, and BBS Shutdown.

The relay contacts shall be made available on the front panel of the BBS via 6, 3 position plug-in terminal blocks with screw down wiring connections.

Each relay, C-1 through C-5 shall have their own common and their own set of normally open (NO) and normally closed (NC) terminals. The terminals for each relay shall be oriented as NO-C-NC on the terminal block. C-6 shall provide continuous 48 VDC voltage for powering of enclosure DC fan.

The contacts on the terminal block shall be labeled 1-18, left to right. Additionally, each set of contact shall be labeled with the NO-C-NC designation, as well as C1…C6 from left to right. Printed labels noting all alarms and faults shall be provided with the BBS Inverter/Charger to be installed when required.

The relay contacts shall be rated at a minimum of 1 amp @ 250 VAC.

The dry relay contacts that are configured for "on battery" shall only energize when the Inverter is operating in Backup Mode

The BBS shall include a timer that will energize the "timer" configured dry relay contact after the user configured time has elapsed. The timer is started when the BBS enters Backup Mode. The user shall be able to configure the timer to the required time. The format shall be Hours, Minutes, Seconds.

The BBS shall have an adjustable low battery relay setting. This setting shall be adjustable so that the user can set the point at which the low battery relay contact is energized.

f. **Communications:** The BBS shall be equipped with an industry standard RS-232 serial connection for user configuration and management. The serial port shall be an EIA-232 (DB9-Female) connector.

The BBS shall have an internal Ethernet communication interface for user configuration and management. The Ethernet Port shall be an RJ-45, EIA 568B Pin-Out Connector.

The BBS shall be include remote monitoring & alarms transmission capabilities through the Ethernet RJ-45 IP Addressable Port, using SNMP protocol.

System shall have the capability of notifying Operations, Maintenance or TMC via e-mail of any alarms, faults or events, user selectable. E-mail set up must allow for different levels of notifications based on the criticalness of the alarms.

All BBS configuration and System menus shall be accessible and programmable from the RS-232 and Ethernet Port.

The BBS shall support TCP and UDP over IP protocol communications.

The BBS shall support, at a minimum application layer protocols, FTP, Telnet, and HTTP.

The BBS shall be SNMP compliant.

g. **Batteries:** The battery shall be comprised of extreme temperature, float cycle, GEL VRLA (Valve Regulated Lead Acid). Individual batteries shall meet the following minimum specifications:
   1. Voltage Rating: 12V

2. Amp-hour rating: 109 AH, at the 20 hour rate, to 1.75 Volts per cell, minimum battery rating. Larger AH batteries are acceptable providing they do not exceed the group size listed below. (Case 31)
3. Group size: Case 31
4. Batteries shall be easily replaced and commercially available off the shelf
5. Batteries shall provide 100% runtime capacity out-of-box. Each battery must meet its specification without the requirement of cycling upon initial installation and after the initial 24-hour top off charge.

Batteries used for the BBS shall consist of a four (4) batteries configured for a 48 VDC battery buss system.

The battery system shall consist of one or more strings of extreme temperature; float cycle GEL VRLA (Valve Regulated Lead Acid) batteries. Batteries shall be certified to operate at extreme temperatures from –40°F to +165°F.

The batteries shall have maintenance-free threaded insert terminals eliminating annual torquing. Battery terminals that require annual torquing of each post connection shall not permitted.

An integral lifting handle should be provided on the batteries for ease of removal/installation.

h. **Cabinet:** The dimensions for the BBS cabinet shall not exceed 50 inches in height, 17 inches in width and 17 inches in depth.

The Inverter/Charger Unit shall be shelf or rack mounted on a standard EIA 19" rack.

The Automatic Transfer switch shall be mounted on EIA 19" Rail.

All interconnect wiring shall be provided and shall be UL Style 1015 CSA TEW.

The BBS equipment and batteries shall be easily replaced and shall not require any special tools for installation.

The BBS inverter and batteries shall be hot swappable. There shall be no disruption to the Traffic Signal when removing the inverter or batteries for maintenance.

All inverter and battery connections shall be of the quick disconnect type for ease of maintenance

All necessary installation hardware (bolts, fasteners, washers, shelves, racks, etc.) shall be included.

The external cabinet shall be capable of housing batteries up to a group 31 size, inverter/charger power module, automatic transfer switch, control panels, wiring, wiring harnesses, and all other ancillary equipment.

The BBS can be installed as specified on the plans and will be either as:
(1) free-standing base-mounted cabinet with optional 8" riser for easy cable entrance.
(2) pole-mounted cabinet with optional pole mount bracket kit.
(3) side-mounted to a Traffic Controller cabinet with no mounting brackets required.

All external cabinets shall be NEMA 3R rated. The enclosure shall be made of a minimum 0.125 (5052-H32) aluminum.

The external cabinet shall be ventilated through the use of louvered vents, filter, and one thermostatically controlled fan. The filter shall be the re-usable type and matching the dimensions of the louver with both located on the bottom half of the door.

The cabinet fan shall be DC operated for longer reliability.

The BBS cabinet shall come with all bolts, washers, nuts required to mount it to a Controller cabinet.

All components, terminations, terminal blocks, relays, etc. shall be fully accessible.

Battery shelves shall be located in the bottom half of the enclosure. The bottom battery shelf shall be removable and the top battery shelf will be welded to the enclosure sides. Air must be allowed for flow from the bottom of the cabinet and up the back internal wall. Neither the top battery shelf nor the Power Module shelf shall inhibit the airflow to the top of the cabinet.

The cabinet shall include a 3 point locking system, including a Type 1 Corbin lock and utilize a handle with pad locking capability.

The following options shall be available for the cabinet:

1. On-Battery lamp mounted externally on the top of the cabinet that illuminates when the BBS is operating in inverter mode.
2. Battery Heater Mats to increase battery capacity in cold climates.
3. Receptacle plate assembly that mounts on the transfer switch panel to provide utility power to the battery heater mats.
4. Automatic Generator Transfer switch that senses a generator is connected and automatically switches to the generator source.
5. Internal lamp with door push-button switch to illuminate the interior of the cabinet.
6. Status monitoring dry contacts for the Automatic Transfer Switch and the Generator Transfer Switch.

i. **Maintenance:** The BBS shall provide voltmeter standard probe input-jacks (+) and (-) to read the exact battery voltage drop at the inverter input.

The BBS Inverter Module shall be programmable to perform automatic self-testing, programmed in weekly intervals and programmed by the user to meet their specific requirements or manufacturer's recommendation. During self-test, the BBS Inverter Module shall identify a weak battery or multiple batteries in the string and notify maintenance by initiating a Weak Battery Alarm.

Provide a remote battery monitor system (RBMS) to be permanently installed into the UPS/Battery cabinet to monitor the UPS batteries (12V battery blocks). The RBMS shall have the ability to monitor, read and record both the battery string and individual battery voltages, admittance (internal battery resistance), individual battery temperatures and to provide a real-time evaluation of the battery bank health.

The RBMS shall have a built-in web interface for SNMP via TCP/IP communications over Ethernet. The device shall be hardened and operate at a temperature range of -40C to +165°F. The device shall include individual 12 volt battery sensors and operate in the range of -40C to +165°F.

The RBMS shall include software to automatically poll each intersection, up to 100 per software

program, reading individual battery voltage, admittance and temperature, confirming each is within its user programmable parameters. The system shall have the ability to program the intervals as to when each reading is taken, by days, weeks or months. The software shall be provided as part of the system cost.

The RBMS shall also perform as a battery balancer, continuously monitoring all batteries in the string and to interface with the UPSs charger voltage/current so to keep the batteries equal with all batteries within the battery string. The RBMS shall allow for any single 12V battery within the battery string to be replaced without replacing all batteries in the string during the battery warranty period.

j. **Warranty:** The BBS System shall include a five (5) year warranty on parts and labor on the entire BBS System, including batteries, to the Agency when utilizing the BBS Manufacturers own designed enclosure, meeting the above cabinet specifications.

The BBS Manufacturer must provide a five (5) year unconditional full replacement warranty for every battery sold to the Agency with the BBS under this specification. Under the warranty time period, the battery must provide a minimum of 70% of its original capacity; otherwise, it will be considered to be non-compliant to the warranty and replaced at no cost to the Agency or DOT by the BBS manufacturer.

k. **Vendor Support:** The BBS manufacturer shall provide a toll-free technical support phone number. The toll-free phone number shall be included in the BBS manual.

Equipment manuals must be provided for each BBS cabinet. Equipment manuals shall include installation, operation, programming, maintenance and troubleshooting.

l. **Quality Assurance:** Each BBS shall be manufactured in accordance with a written manufacturer's Quality Assurance program. The QA program shall include, as a minimum, specific design and production QA procedures.

The BBS Power Module manufacturer shall be ISO 9001 or ISO 9002 certified and equipment shall meet UL standards testing.

1021-6 SIGNS: All detailed sign shop drawings shall be submitted to EBR Traffic Engineering Division prior to ordering signs. Details shall include but not limited to all dimensions for the sign, symbols, uppercase letters, lowercase letters, spacing, border, overall, radius corners, as well as show font, substrate, border, sheeting, thickness, and colors. Contractor shall obtain approval from the EBR Chief Traffic Engineer prior to ordering signs.

1021.6.1 Traffic Signs: See Specification 905 and Pay Item 9050200 TRAFFIC SIGNS. This pay item includes typical regulatory and warning signs that are included in the MUTCD to be installed at intersections. All metal signs shall conform to the Manual on Uniform Traffic Control Devices (MUTCD), latest adopted edition and all subsequent adopted revisions thereto and its corresponding Standard Highway Signs and Markings Manual (SHSM).

1021-6.2 Street Name Signs: See Specification 905 and Pay Item 9050200 TRAFFIC SIGNS. All Street Name Signs located within City-Parish right-of-way shall conform to the Manual on Uniform Traffic Control Devices (MUTCD), latest adopted edition and all subsequent adopted revisions thereto and its corresponding Standard Highway Signs and Markings Manual (SHSM).

1021-6.3 Fiber Optic Signs: See Specification 905 and Pay Item 9050200 TRAFFIC SIGNS. This item shall

consist of the Contractor furnishing and installing warning signs along fiber interconnect routes in the concrete apron on all fiber junction boxes as shown on the plans. The Contractor shall install fiber optic signs in accordance with the plans, City-Parish Standard Plans, Specification Section 905, and the latest adopted edition of the Manual of Uniform Traffic Control Devices (MUTCD).

At all fiber optic junction boxes, the Contractor shall provide and install a 6" x 16" sign reading "*Caution, Buried Traffic Fiber Optics Cable, Before Digging Call Traffic Engineering Division, 389-3243*," on a six foot (6') foot U-channel post located within the junction box concrete collar. Sign shall be installed on side of junction box, not on ends, allowing for proper opening of junction boxes. A four-inch (4") PVC pipe cut off level with the concrete shall be left to allow signpost replacement. A six (6) feet U-channel post shall be included with the sign.

1021-6.4 Blank Out Signs: This item consists of furnishing all necessary equipment, labor and material to install blank out signs as described in this specification.

a. **Functional Requirements:** All messages shall be clearly legible attracting attention under any lighting conditions. At full intensity the sign will be highly visible anywhere within an approximate 60" cone centered about the optic axis.

   The sign shall completely blank out when not energized. No phantom words or legend shall be seen under any ambient light condition. Messages are displayed by a single or double row of glass fiber bundles (depending upon application). In most applications, bundles shall be arranged so that in the event of failure of one light source the other shall continue to provide a discernible message.

   The entire sign face is protected by a 1/8" matt/clear polycarbonate lens mounted in the doorframe.
   The sign shall consist of:
   1. Weatherproof housing and door
   2. Fiber optic module
   3. Color filters for desired message colors
   4. Light sources
   5. Transformers

   The color of any message may be changed in the field by replacement of the color filters without removing the sign from the case. Forty-two (42W) watt lamps shall be used and operated at 10.8 volts. The lamps shall sustain an average 8,000 hour life. Transformers shall be used to reduce the incoming 120 volts AC to 10.8 volts AC. The transformers shall contain Class A insulation and weatherproofing, and shall be rated at 48.5 volt-amps. The sign shall be capable of continuous operation over a range in temperatures from –30° to +165°F (-34° to 74° C).

b. **Mechanical Construction**
   1. **Aluminum Housings**
      i. Two-way housings shall be constructed of .063 aluminum body and a .063 aluminum channel framework structure inside. Housing boy and inside framework shall be permanently attached to form a signal unit.
      ii. One-way housings shall be constructed of .080" or .125" extruded aluminum 8" deep with a .036" flat aluminum back welded into the housing.
      iii. All corners and seams of the one or two-way housings are heli-arc welded to provide a weatherproof seal around the entire case.
      iv. Continuous stainless set of hinges, .040 x 1-1/4" open shall connect the housing and doors.
      v. 0.125" extruded aluminum doors shall have one side removable to gain access to sign

face. (Not required for routine maintenance.)

vi. Door gaskets shall be 3/16" x 1" neoprene to provide a weatherproof seal.

vii. Sign face shall be flat aluminum and shall have the fiber optic assembly mounted to it.

viii. Sign shall have one or more stainless steel #3, ¼ turn link-locks per door to tightly secure the door into the gasket.

ix. Mounting hubs shall be of cast aluminum alloy with 1-1/2" standard pipe thread. The hub is mounted on its gasket to sign housing by three 5/16" x 1" stainless steel hex head bolts and nuts.

x. Drainage shall be provided by four, drain holes located at the four corners of the housing bottom.

c. **Fiber Optic Modules**

1. The fiber optic modules and associated components shall be assembled directly to the sign face and shall have an inside back cover to provide protection to the module. The fiber shall consist of fiber optic glass bundles arranged to define the required message. The fiber optic bundles shall be ground smooth and optically polished at the input and output ends for maximum light transmission.
2. The glass bundles shall be mounted through the sign face from the inside. Number of bundles varies according to message.
3. Door panels and bundle terminations holders shall be colored flat black to minimize legibility when activated. No color shall appear when deactivated regardless of ambient light conditions.
4. 3Message color is provided by a tempered, optically correct glass color filler in conformance with ITE specifications.
5. Electrical connection of field wires shall be made via barrier type terminal strip.
6. All fasteners and hardware shall be corrosion resistant stainless steel. All components shall be readily accessible for maintenance when the door is open.
7. With standard hardware and locks, no tools are needed for lamp replacement.

Signs shall be symbol type as shown on the plans unless approved otherwise.
Contractor shall provide product submittal to EBR Traffic Engineering Division for approval prior to ordering equipment.

1021-7 COMMUNICATIONS

1021-7.1 Fiber Optic Cable: This section includes the furnishing; installing and testing of fiber optic interconnect (communications) cable, equipment and materials related to the fiber-optic components of the closed loop communication system. This fiber shall accommodate traffic signal and surveillance camera communications as shown on the plans.

This stranded loose tube cable design shall be used as the main cable type between controller cabinets, cameras, signs or other devices. The cable configuration shall be dictated by the particular communication path, data rate, and distance of the optical path. Single-mode (SM) fiber shall be used.

a. **General Considerations:** The cable shall be an accepted product of the United States Department of Agriculture Rural Utilities Service (RUS) 7 CFR 1755.900 and meet the requirements of ANSI/ICEA Standard for Fiber Optic Outside Plant Communications Cable, ANSI/ICEA S-87-640-1999. In addition, the cable shall meet all requirements stated in this specification.

The cable(s) shall be all-dielectric stranded loose tube design. For fiber counts > 24 fibers, a three (3) place configuration with two (2) buffer tubes and a central member with a common round jacket, providing it meets all requirements contained herein, shall be acceptable.

The cable(s) shall be new, unused and of current design and manufacture.
The cabled fiber and cable provided shall come from the same manufacturer to ensure comprehensive technical and warranty support.

b. **Fiber Specifications:** All fibers in the cable must be usable and meet required specifications.

Single mode fiber shall be SMF-28e.

Each optical fiber shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification.

Each optical fiber shall consist of a Germania doped silica core surrounded by a concentric glass cladding. The fiber shall be a matched clad design.

Each optical fiber shall be proof tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m2).

The fiber shall be coated with a dual layer acrylate protective coating. The coating shall be in physical contact with the cladding surface.

The attenuation specification shall be a maximum value for each fiber at 23 ± 5 °C.

The single-mode fiber utilized in the optical fiber cable shall meet EIA/TIA-492CAAA, "Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers," and ITU recommendation G.652, “Characteristics of Single-Mode Optical Fiber Cable.”

Parameter	**Single-Mode Fiber**
Typical Core Diameter	8.3 μm (characterized value)
Cladding Diameter	125.0 ± 0.7 μm
Core-to-Cladding Concentricity	≤ 0.5 μm
Cladding Non-Circularity	≤ 1.0 % $\left(1-\frac{\text{Minimum Cladding Diameter}}{\text{Maximum Cladding Diameter}}\right)\times 100$
Coating Diameter	245 ± 5 μm
Attenuation (maximum)	0.40/0.30 dB/km @ 1310/ 1550nm
Attenuation Uniformity	No point discontinuity > 0.10 dB at either 1300 nm or 1550 nm
Attenuation at the Water Peak	At 1383 ± 3 nm shall not exceed 0.35 dB/km
Cutoff Wavelength (cabled) (λ_{ccf})	< 1260 nm
Mode Field Diameter	9.20 ± 0.4 μm at 1310 nm 10.40 ± 0.8 μm at 1550 nm
Macrobend Attenuation	1 turn of fiber around a 32 ± 2 mm diameter mandrel ≤ 0.50 dB at 1550 nm. 100 turns of fiber around a 75 ± 2 mm diameter mandrel ≤ 0.05 dB at 1310 nm and ≤ 0.10 dB at 1550 nm.

Zero Dispersion Wavelength (λo):	1302 nm ≤ λo ≤ 1322 nm
Zero Dispersion Slope (So)	≤ 0.092 ps/(nm²•km)
Maximum dispersion	≤ 3.55 ps/(nm•km) 1285 nm - 1330 nm ≤ 18 ps/(nm•km) at 1550 nm
Fiber Curl	> 4.0 m radius of curvature
Fiber Polarization Mode Dispersion (PMD)	≤ 0.5 $ps/\sqrt{km}$

c. **Specifications for Outdoor Cable Construction:** Optical fibers shall be placed inside a loose buffer tube. The nominal outer diameter of the buffer tube shall be 3.0 mm, regardless of the fiber count. Each buffer tube shall contain up to twelve (12) fibers. 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-A, "Optical Fiber Cable Color Coding." The fibers shall be colored with ultraviolet (UV) curable inks.

Buffer tubes containing fibers shall be color-coded with distinct and recognizable colors in accordance with TIA/EIA-598-A, "Optical Fiber Cable Color Coding."

Buffer tube colored stripes shall be inlaid in the tube by means of co-extrusion when required. The nominal stripe width shall be one millimeter (1 mm).

For cables containing more than twelve (12) buffer tubes, standard colors are used for tubes one (1) through twelve (12) and stripes are used to denote tubes thirteen (13) through twenty-four (24). The color sequence applies to tubes containing fibers only, and shall begin with the first tube. If fillers are required, they shall be placed in the inner layer of the cable. The tube color sequence shall start from the inside layer and progress outward.

In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together.

The buffer tubes shall be resistant to external forces and shall meet the buffer tube cold bend and shrink-back requirements of 7 CFR 1755.900.

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

Fillers shall be placed so that they do not interrupt the consecutive positioning of the buffer tubes. In dual layer cables, any filler shall be placed in the inner layer. Fillers shall be nominally three millimeter (3.0 mm) in outer diameter.

The central member shall consist of a dielectric, glass reinforced plastic (GRP) rod. The purpose of the central member is to provide tensile strength and prevent buckling. The central member shall be over-coated with a thermoplastic when required to achieve dimensional sizing to accommodate buffer tubes/fillers.

Buffer tubes shall be stranded around the dielectric central member using the reverse oscillation,

or "S-Z", stranding process. Water swellable yarn(s) shall be applied longitudinally along the central member during stranding. The water swellable yarn shall be non-nutritive to fungus, electrically non-conductive, and homogenous. It shall also be free from dirt and foreign matter. This yarn will preclude the need of other water-blocking material; the buffer tube shall be gel free. The optical fibers shall not require cleaning before placement into the splice tray or fan-out kit.

A water swellable tape shall be applied longitudinally around the outside of the stranded tubes/fillers. The water swellable tape shall be non-nutritive to fungus, electrically non-conductive, and homogenous. It shall also be free from dirt and foreign matter.

Two polyester yarn binders shall be applied contra-helically with sufficient tension to secure each buffer tube layer to the dielectric central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking, and dielectric with low shrinkage.

For dual layer cables, a second (outer) layer of buffer tubes shall be stranded over the original core to form a two-layer core. A water swellable tape shall be applied longitudinally over both the inner and outer layer. The water swellable tape shall be non-nutritive to fungus, electrically non-conductive, and homogenous. It shall also be free from dirt and foreign matter.

The cables shall contain at least one ripcord under the sheath for easy sheath removal.

Tensile strength shall be provided by the central member, and additional dielectric yarns as required. The dielectric yarns shall be helically stranded evenly around the cable core. The central member and/or other strength members shall not cause the cable to have a preferential bend.

Non-armored cables shall be sheathed with medium density polyethylene (MDPE). The minimum nominal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members (as required) and water swellable tape. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

The jacket or sheath shall be free of holes, splits, and blisters. The cable jacket shall contain no metal elements and shall be of a consistent thickness.

Cable jackets shall be marked with the manufacturer's name, month and year of manufacture, sequential meter or foot markings, a telecommunication handset symbol as required by Section 350G of the National Electrical Safety Code® (NESC®), fiber count, and fiber type. In addition to these standard markings, the cable shall also be marked with "City Parish Traffic Signal Cable" in the same print and manner as the standard print. The actual length of the cable shall be within -0/+1% of the length markings. The print color shall be white. The height of the marking shall be approximately 2.5 mm. The location of switch back points shall be marked on the outer jacket to facilitate mid-span access. Re-marking during the manufacturing process shall not be allowed.

The maximum pulling tension shall be 2700 N (608 lbf) during installation (short term) and 890 N (200 lbf) long term installed.

The shipping, storage, and operating temperature range of the cable shall be -40°C to +70°C. The installation temperature range of the cable shall be -30°C to +70°C.

d. **General Cable Performance Specifications:** When tested in accordance with FOTP-3,

"Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components," the change in attenuation at extreme operational temperatures (-40°C and +70°C) shall not exceed 0.15 dB/km at 1550 nm for single-mode fiber and 0.3 dB/km at 1300 nm for multi-mode fiber.

When tested in accordance with FOTP-82, "Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable," a one-meter length of unaged cable shall withstand a one-meter static head or equivalent continuous pressure of water for one hour without leakage through the open cable end.

When tested in accordance with FOTP-81, "Compound Flow (Drip) Test for Filled Fiber Optic Cable," the cable shall exhibit no flow (drip or leak) of filling and/or flooding material at 70°C. When tested in accordance with FOTP-41, "Compressive Loading Resistance of Fiber Optic Cables," the cable shall withstand a minimum compressive load of 220 N/cm (125 lbf/in) applied uniformly over the length of the sample. The 220 N/cm (125 lbf/in) load shall be applied at a rate of 2.5 mm (0.1 in) per minute. The load shall be maintained for a period of 1 minute. The load shall then be decreased to 110 N/cm (63 lbf/in). Alternatively, it is acceptable to remove the 220 N/cm (125 lbf/in) load entirely and apply the 110 N/cm (63 lbf/in) load within five minutes at a rate of 2.5 mm (0.1 in) per minute. The 110 N/cm (63 lbf/in) load shall be maintained for a period of 10 minutes. Attenuation measurements shall be performed before release of the 110 N/cm (63 lbf/in) load. The change in attenuation shall not exceed 0.15 dB at 1550 nm for single-mode fibers and 0.3 dB at 1300 nm for multi-mode fiber.

When tested in accordance with FOTP-104, "Fiber Optic Cable Cyclic Flexing Test," the cable shall withstand 25 mechanical flexing cycles around a sheave diameter not greater than 20 times the cable diameter. The change in attenuation shall not exceed 0.15 dB at 1550 nm for single-mode fiber and 0.3 dB at 1300 nm for multi-mode fiber.

When tested in accordance with FOTP-25, "Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies," except that the number of cycles shall be two at three locations along a one meter cable length and the impact energy shall be at least 4.4 Nm (in accordance with ICEA S-87-640)", the change in attenuation shall not exceed 0.15 dB at 1550 nm for single-mode fiber and 0.3 dB at 1300 nm for multi-mode fiber.

When tested in accordance with FOTP-33, "Fiber Optic Cable Tensile Loading and Bending Test," using a maximum mandrel and sheave diameter of 560 mm, the cable shall withstand a rated tensile load of 2670N (601 lbf) and residual load of 30% of the rated installation load. The axial fiber strain shall be ≤ 60% of the fiber proof level after completion of 60 minute conditioning and while the cable is under the rated installation load. The axial fiber strain shall be ≤ 20% of the fiber proof level after completion of 10 minute conditioning and while the cable is under the residual load. The change in attenuation at residual load and after load removal shall not exceed 0.15 dB at 1550 nm for single-mode fiber and 0.3 dB at 1300 nm for multi-mode fiber.

When tested in accordance with FOTP-85, "Fiber Optic Cable Twist Test," a length of cable no greater than 2 meters shall withstand 10 cycles of mechanical twisting. The change in attenuation shall not exceed 0.15 dB at 1550 nm for single-mode fiber and 0.3 dB at 1300 nm for multi-mode fiber.

When tested in accordance with FOTP-37, "Low or High Temperature Bend Test for Fiber Optic Cable," the cable shall withstand four full turns around a mandrel of ≤ 20 times the cable diameter after conditioning for four hours at test temperatures of -30°C and +60°C. Neither the inner nor the outer surfaces of the jacket shall exhibit visible cracks, splits, tears, or other

openings. The change in attenuation shall not exceed 0.3 dB at 1550 nm for single-mode fiber and 0.5 dB at 1300 nm for multi-mode fiber.

e. **Quality Assurance Provision:** All cabled optical fibers > 1000 meters in length shall be 100% attenuation tested. The attenuation of each fiber shall be provided with each cable reel.

The cable manufacturer shall be ISO 9001 registered.

f. **Packaging:** The completed cable shall be packaged for shipment on non-returnable wooden reels or steel reels. The cable shall be protected from damage with a flexible cover wrapped around the cable between reel flanges.

Top and bottom ends of the cable shall be available for testing. Both ends of the cable shall be sealed to prevent the ingress of moisture. Each reel shall have a weather resistant reel tag attached identifying the reel and cable. The reel tag shall include the following information:

Cable Number Gross Weight
Shipped Cable Length in Feet Job Order Number
Manufacturer Product Number Customer Order Number
Date Cable was Tested Manufacturer Order Number
Cable Length Markings Item Number
a: Top (inside end of cable)
b: Bottom (outside end of cable)

The reel (one flange) marking shall include:

"Manufacturer" Country of origin (e.g., USA)
An arrow indicating proper direction of roll when handling
Fork lift-handling illustration
"DO NOT SHIP REEL ON SIDE" or
“DO NOT LAY REEL ON ITS SIDE”

Each cable shall be accompanied by a cable data sheet. The cable data sheet shall include the following information:

Manufacturer Cable Number	Manufacturer Product Number
Manufacturer Factory Order Number	Customer Name
Customer Purchase Order Number	Ordered Length
Maximum Billable Length	Actual Shipped Length
Measured Attenuation of Each Fiber (for lengths > 1000 m)	Bandwidth Specification (where applicable)

g. **Miscellaneous:** The cable manufacturer shall provide installation procedures and technical support concerning the items contained in this specification.

The manufacturer shall provide a 24-hour technical assistance hotline.

Cable and fiber manufacturer shall be vertically integrated to ensure long-term reliability of the cabled fiber and to ensure comprehensive technical support and warranty support.

h. **Fiber-Optic Drop Cable, 12 fiber Single-mode:** This cable design shall be used to provide a

communication path between field devices and the main trunk cable of the system. This cable design is more flexible with a much smaller bend radius than stranded loose-tube cable and shall be used in conjunction with preterminated patch panels. The technical requirements of this cable shall be the same as the trunk cable with the following exceptions.

i. **Cable Construction:** Optical fibers shall be placed in a single filled loose buffer tube with a nominal diameter of 3.0mm. In the case of a hybrid design, the single-mode fibers shall be the first fiber colors in the tube. For this project, a single-mode 12 count fiber cable shall be used.

Water swellable dielectric strength members shall be applied evenly around the outside of the buffer tube for tensile strength. The dielectric strength members shall be non-nutritive to fungus and electrically nonconductive. They shall also be free from dirt and foreign matter. Water blocking shall be provided by the strength members, which shall be impregnated with a water swellable compound. The cable shall not have stiff longitudinal rods or any other component that will cause the cable to have a preferential bend.

Cables shall be sheathed with flame-retardant polyvinyl chloride (PVC). The nominal jacket thickness shall be 1.4 mm. The jacketing material shall be applied directly over the tensile strength members. The PVC shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus. The cable shall meet must meet the requirements of the National Electrical Code® (NEC®) Section 770. for Non-Plenum Applications - Applicable Flame Tests: ANSI/UL 1666. The cable shall be listed OFNR. The cable shall contain no metallic elements.

Drop Cable Fiber and Cable Parameters	
Parameter	Value
Multi-mode attenuation	3.5/1.0 @ 850/1300nm
Single-mode attenuation	0.4/0.3 db/km @ 1310/1550nm
Coated fiber diameter	245 ± 5 μm
Minimum bend radius (loaded)	10.5 mm (4.1”)
Minimum bend radius (unloaded)	7.0 mm (2.8”)
Tensile rating short term (Installation)	1320 N (300lbf)
Tensile rating installed (long term)	330N (73lbf)
Nominal outer diameter	7.0mm (0.28”)

j. **Installation:**

1. **General Outside Plant Cable Installation:** The Contractor shall submit for approval a detailed construction and installation procedure covering all aspects of the construction and installation process for each specific cable type to be used on this project. Secure from the cable manufacturer the construction and installation procedures to be used on the project. The construction and installation procedure shall be submitted for review by the City Chief Traffic Engineer or a designated Project Engineer.

2. **Cable Installation Procedures and Standards-Safety Precautions:** The Contractor shall follow all appropriate OSHA and industry standards related to safety when working in manholes or underground vaults and when handling optical fibers.

3. **Cable Handling:** The Contractor shall install all fiber optic cable according to the manufacturer’s recommended procedures and these specifications.

4. **Pulling Tension:** The Contractor shall not exceed the maximum recommended pulling tension during installation as specified by the cable manufacturer. Prior to installation of any fiber-optic, the Contractor shall provide documentation as to how tension will be monitored during cable installation. Cable placed without provisions for tension control shall be considered unfit for use and shall be replaced at the Contractor's expense.

5. **Allowable Bend Radius:** The Contractor shall not violate the minimum recommended bend radius during installation as specified by the cable manufacturer. Unless the manufacturer's recommendations are more stringent, use the following guidelines for minimum bend radius:

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

6. **Cable Installation Guidelines:** Before the installation begins; carefully inspect the cable reels for imperfections such as nails that might cause damage to the cable as it is unreeled. Take all necessary precautions to protect reeled cable from vandals or other sources of possible damage while unattended. Any damage to the cable sections may require replacement of the entire section. Whenever unreeled cable is placed on the pavement or surface above a manhole, provide means of preventing vehicular or pedestrian traffic through the area in accordance with the Specification. Use the "figure-eight" method to prevent kinking or twisting when the cable is unreeled or back-fed. Do not coil fiber optic cable in a continuous direction except for lengths of one hundred feet (100') or less. The preferred size for the "figure-eight" is fifteen feet (15') in length, with each loop five feet (5) to eight feet (8') feet in diameter. When "figure-eighting" cable, exercise care to relieve pressure on the cable at the crossover points of the eight, this may be done by placing cardboard shims at the crossover or by forming a second "figure-eight". Keep the cable continuous throughout the pull. Cable breaks are allowed only at designated splice or end points.

7. **Cable End Sealing:** After cable placement, all cable ends shall be sealed with an appropriate sized cable cap to prevent water ingress.

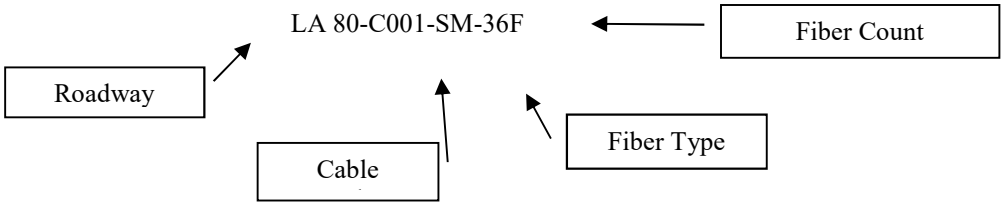
8. **Slack Cable:** The Contractor shall provide slack cable for future terminations or splicing. Unless otherwise noted on the plans, the following are the requirements for slack cable storage:

   i. Trunk cable at splice locations shown on the plans (Type J junction boxes) (coiled uncut slack) – one hundred foot (100') slack cable
   ii. Trunk cable at mid span slack storage locations (Type I junction boxes) (coiled uncut slack) - fifty foot (50') slack cable
   iii. Drop cable (in controller cabinet) end point – fifty foot (50') slack cable

   Properly store all cable to minimize susceptibility to damage. Maintain proper bend radius, both short and long term, during cable storage. The Contractor shall hand coil drop cable slack and secure with cable ties inside the controller cabinet and shall not exceed the minimum bend radius of the fiber.

9. **Cable Marking:** The cable label shall be a minimum of 2" wide wrap around style with a clear film over-wrap. It shall be specifically designed for outside plant environments. Use only permanent marking pens, as recommended or provided by the manufacturer. For all cable applications, legibly print the Roadway number, cable ID number, Fiber Type, and

fiber count as shown in the Plans with a permanent-marking pen as recommended by the label manufacturer and seal with a laminate covering. The following is an example of the cable labeling scheme:



Clean the installed cable of all dirt and grease before applying any label. Follow the label manufacturer's recommended procedure for applying cable labels. Label all cables in every pull box and splice closure.

Place cable labels in the following locations:

i. Within eighteen inch (18") of every cable at its entry to a pull box
ii. Within eighteen inch (18") of every cable at its exit from a pull box (in the case of coiled slack)
iii. Within eighteen inch (18") of every cable entry into a splice closure (underground only)

For drop cables, label as "Drop to Intersection name/number".

Unless noted, all optical fiber splices shall be fusion splices. Mechanical splices shall not be used on EBR projects. Splices shall be made with a fusion splicing machine capable of active fiber alignment via Local injection/detection or PAS. Maximum splice loss allowable shall be 0.10 dB.

Splices shall be protected using an industry standard sixty millimeter (60 mm) heat shrink protection sleeve incorporating a stainless steel rod. Protection sleeves shall be shrunk using a heat-shrink oven; no open flame, heat gun or other device shall be used.

10. **Identification Tape:** All underground conduit installed by open trenching methods shall be identified by conduit identification tape. Identification tape shall be minimum six (6") inches wide and be of a plastic-based non-deteriorating non-color-fading material capable of stretching at least six hundred percent (600 %) in length before breaking. Identification tape shall be colored in accordance with American Public Works Association orange for communications and shall be continuously emblazoned with black non-fading ink with the message "CAUTION FIBER OPTIC TRAFFIC SIGNAL CABLE BURIED BELOW" in minimum two (2") inch high block letter. Identification tape shall be installed for the entire length of trench directly above the conduit(s). One (1) length of identification tape shall be installed for all parallel conduits within twelve (12") inches of each other; parallel conduits more than twelve (12") inches apart shall have two (2) or more identification tapes as needed. The identification tape shall be continuous from conduit termination point to termination point and shall enter pull boxes with the conduit. The identification tape shall be at a depth of twelve (12") inches below finished grade. No separate payment will be made for Identification tape, but shall be provided by the Contractor as part of the pay item for the pay item for the Fiber Optic Cable.

11. **Tracer Wire:** All Conduit shall include a #10 stranded tracer wire for all conduit used for the installation of fiber optic cables. No separate payment will be made for Tracer wire, but shall be provided by the Contractor as part of the pay item for the Fiber Optic Cable.

12. **Testing:** The Contractor shall notify the Traffic Engineering Division in writing a minimum of seven (7) days before the scheduled start of any tests to permit attendance of the appropriate personnel. The Contractor shall be totally responsible for the documentation of the results of all tests. The documented test results shall be submitted to the Traffic Engineering Division for approval within fifteen (15) days following completion of the test. During the fiber optic conductor cable tests, all transient suppression devices shall be disconnected. If any test is failed, repairs or cable replacement shall be made by the Contractor and the entire test series for the fiber optic cable shall be repeated. The cost or repairs including the replacement or reinstallation of cable shall be absorbed by the Contractor. All test equipment shall be provided by the Contractor and all tests shall be conducted in the presence of the City Traffic Engineering Division or a designated Project Engineer. The Contractor shall perform the tests and document the test results. When the tests are completed, whether successful or not, the test results shall be furnished to the Traffic Engineering Division or a designated Project Engineer. The tests shall be conducted for all fibers including spares and shall include all field terminations. Test procedures shall be submitted to the Traffic Engineering Division or a designated Project Engineer for approval prior to testing. No separate payment will be made for testing, but shall be provided by the Contractor as part of the pay item for the Fiber Optic Cable and/or Pay Item 9060100 Traffic Signal System Lump Sum.

13. **Pre-installation OTDR Testing:** The Contractor shall test all fibers in each reel of cable prior to installation. This testing is for both continuity and attenuation. The tests shall be conducted at 1550nm for single-mode fibers. The testing shall be performed by a qualified technician using an Optical Time Domain Reflectometer (OTDR) via a "pigtail" splice. The pigtail (pulse suppressor) shall be a minimum of one hundred meters (100m) to allow the entire length of fiber under test to be visible on the trace. The resultant OTDR trace(s) shall reflect overall length, attenuation expressed in dB/km, and shall indicate no point discontinuity >0.10 dB. All test results shall be within ±0.02 dB/km of factory supplied attenuation measurements for single-mode fibers. Testing shall be conducted in one (1) consistent direction only.

    Resulting OTDR traces shall be supplied to the Traffic Engineering Division or a designated Project Engineer by the Contractor in hard copy and electronic format prior to installation of the cable. The Contractor may opt to accept factory results and install cable at his own risk. However, if cable should fail after installation and prior to acceptance of the system, the Contractor shall remove failed cable and reinstall new cable at his sole expense. In either case, On-the-reel test results shall be provided to the Traffic Engineering Division or a designated Project Engineer for each cable installed prior to cable installation.

    Following installation, each section of the installed cable shall be tested for continuity and attenuation as indicated above. The traces shall demonstrate that no damage has occurred during installation and that any splices meet the requirements herein. The traces shall be included in the documentation package provided at the conclusion of the contract.

14. **Post installation Testing:** Only connectorized spans will be tested for final End-to-End attenuation (power loss). The testing shall be performed at 1300nm and 1550nm for single-mode fibers. The testing shall be conducted using “hand-held” optical test sets and shall be conducted using a two jumper reference. The testing shall be in both directions.

The results shall be tabulated and be included in the documentation package provided to the Traffic Engineering Division or a designated Project Engineer at the conclusion of the contract. Overall loss for each link shall not exceed the cumulative specified losses of the components in the link.

(EXAMPLE, @ 850nm, a 1 km link with 2 splices and a connector on each end shall not exceed 5.0dB ((3.5dB + .25dB + .25dB +.5dB + .5dB)). At the conclusion of the contract, two (2) copies of system documentation package shall be provided. It shall include as a minimum:

i. Post installation OTDR traces for each fiber.
ii. End-to-End Attenuation measurement for each fiber.
iii. A splice plan showing the location and configuration of any splices in the system as well as how the transmission scheme is set up.
iv. Reference manuals for equipment provided.

No additional payment shall be made for testing of fiber.

15. **Contractor Warranty and Maintenance:** Any and all warranties and guarantees shall comply with Section 4-6 of the Standard Specifications.

16. **Submittals:** Prior to any work, obtain approval from the Traffic Engineering Division or a designated Project Engineer for the products and procedures to be used or furnished on the project. Submittal data shall be organized in an orderly manner; separate data by material type. Provide four copies of the submittal package to the Traffic Engineering Division or a designated Project Engineer. The following table details the submittal requirements for the equipment for a particular pay item. The table is a guideline and does not relieve the Contractor from submitting additional information to form a complete submittal package.

Material	Catalog Cuts	Mfg. Specs	Factory Test	Install. Docs.	Test Schedule	Test Plan	Test Reports	Submittal Due Date (Cal. Days after NTP)
FO Cable (Trunk and Drop)	X	X	X	X	X	X	X	30 Days
Splice Closure	X	X	X	X				30 Days
Splice Tray	X							30 Days
Preterminated Patch Panel	X	X	X				X	30 Days
Fusion Splice	X	X					X	30 Days
FO Patch Cords	X	X	X					30 Days
Ethernet Switch	X	X						30 Days
Cable Labels	X	X		X				30 Days

1021-7.2 Fiber Optic Fan Out Kits:

This Item consists of furnishing and installing fiber optic fan out kits and all appurtenances required for the ITS in accordance with plan details, these specifications, and as directed by the engineer. All equipment shall be new and constructed using the highest quality, commercially available components and techniques to assure high reliability and minimum maintenance. The contractor shall submit, prior to installation, a complete set of shop

drawings of all the equipment and components listed below and included as part of the installation. The contractor shall assemble and install all necessary material and equipment and furnish a working fiber optic fan out in accordance with these plans and specifications and compatible with the requirements of the ITS. All items that are required to complete the installation and ensure an operational ITS shall be supplied by the contractor whether listed above or not. Items required but not listed above shall be at no direct pay. All components supplied by the contractor are the responsibility of the contractor.

Buffer tube fan outs shall be used when fiber optic drop cable is required to be connectorized as indicated on the plans. Whip style fan outs for loose tube cable shall be provided in either a six or twelve fiber configuration. The 900 um fan out assembly shall be color coded to match the fiber color scheme. The fan out shall be a minimum of 25 inches in length. The fan out shall consist of a two piece snap together body which locks the fan out to the buffer tube. Fan outs shall be rated for outdoor use within a temperature range of -40 F to +158 F.
No epoxy, heat shrink tubing, glue, or field sub-assembly shall be necessary to install the fan out. Buffer tube fan outs shall be used where fiber is terminated inside a fiber distribution panel. Fan out kits shall be from the same manufacturer as the fiber cable.

1021-7.3 Fiber Optic Connection, Splice:

a. **General Requirements:** Prior to any fiber splicing, the fiber optic splicing diagrams for the backbone, subtending and drops shall be submitted and accepted.

   Refer to plan details for specific fibers being spliced and those being expressed.

   The loss through any one fusion splice shall be 0.07 dB or less.

   The complete fusion splice points for the fiber optic cable shall occur only within pull boxes as designated by the engineer. At each of these points, a submersible splice enclosure suitable for a minimum of 72 fusion splices shall be utilized. This enclosure shall allow for installation of a fiber optic drop cable that shall be routed to the termination point. Industry accepted standards and manufacturer's specifications shall be followed for installation of splice enclosures and fusion splices.

   Fusion splicing shall be utilized for all splices and manufacturer's specifications for equipment and fiber cable shall be followed.

b. **Total Cable Fusion Splice Points:** All fiber optic cables shall be continuous with no total cable splices. Full butt splices are allowed only due to the physical limitations of the length of fiber that can be placed on the reel. Payment for butt splices due to the physical imitation of the reel, are included as part of the backbone fiber. The electrically conductive path used for continuity and grounding of the splice closure metallic components shall be capable of withstanding an AC current of 1000 Amperes for 20 seconds.

   The closure shall show no evidence of water intrusion into the compartment containing fiber splices after it is immersed in water and subjected to 10 freeze/thaw cycles. The splice closure shall show no evidence of water penetration following exposure to a 20-foot water head for a period of 7 days.

   The splice closure shall show no evidence of corrosion following exposure to acidified saltwater for a period of 90 days.

1021-7.4 Fiber Optic Connection, Termination:

All equipment shall be new and constructed using the highest quality, commercially available components and techniques to assure high reliability and minimum maintenance. The contractor shall submit, prior to installation a complete set of shop drawings of all the equipment and components listed below and included as part of the installation.

The contractor shall assemble and install all necessary material and equipment and furnish a working fiber optic termination in accordance with these plans and specifications and compatible with the requirements of the ITS. All items that are required to complete the installation and ensure an operational ITS shall be supplied by the contractor whether listed above or not. Items required but not listed above shall be at no direct pay. All components supplied by the contractor are the responsibility of the contractor.

The contractor shall field verify final equipment locations with the EBR Traffic Engineering Division. Plans are diagrammatic and indicate the general arrangement of devices and work included in these documents. Final placement and arrangement are the responsibility of the contractor.

The loss through any terminus connector pair shall be 0.5 dB or less. Reflectance shall be below -45 db.
Acceptable fiber optic connectors shall be SC or LC and are referenced in this specification as connectors. The contractor shall verify that connector type is compatible with hardware fiber ports. Industry standards related to fiber termination shall be followed. Connectors shall have pre-radiused zirconia ceramic ferrule, connector body, blue shroud, black or blue 3.0 mm and a 900um boots. Connectors shall be compatible with mechanical, two part heat cure epoxy and anaerobic adhesive assembly methods.

Connectors shall be used throughout the fiber optic system installation for terminating fibers and for jumping between termination points, unless otherwise required by a network device. Fusion splicing shall be utilized for all splices and manufacturer's specifications for equipment and fiber cable shall be followed.

Manufacturer's specifications for terminating the fiber cable and for utilization of the termination device shall be followed. In addition, industry standard practices for fiber termination shall also be followed. Plan details provide termination diagrams for each termination point and a numbering scheme for the fiber cables that will be followed throughout the layout of the network.

Each strand of each cable being terminated shall be appropriately labeled with origination and destination information, when defined.

See plan sheets and general notes for site or project specific information regarding installation of this item.

1021-7.5 Fiber Optic Patch Cord:

Patch Cord Single Mode 4F SC LC: Any patch cords used for system configuration shall be compatible with fiber types and connectors specified herein. Single-mode patch cords shall be yellow in color. All cordage shall incorporate a 900um buffered fiber, aramid yarn strength members, and an outer jacket. Patch cords may be simplex (1 fiber) or duplex (2 fiber), depending on the application. Simplex patch cords shall be constructed of 3.0mm OD cordage, Duplex patch cords shall be constructed of "zip cord" cordage with a nominal diameter of 2.0mm x 4.0mm. All patch cords will feature factory terminated, heat cure ceramic ferrule connectors. Strength members of the cordage shall be crimped to the connector body. Insertion loss for each connector @ 1310nm shall be <0.40 dB for single-mode connectors. Return loss for single-mode connectors shall be > -40dB. Patch cords shall have part number, manufacturer, and lot number affixed to on the jacket of the assembly. Test measurements shall be documented and shall be included with the packaging of each assembly. SC/LC duplex patch cords shall have contrasting boot colors at each end of the assembly to designate transmit and receive functions. For duplex patch cords, a user-installed clip to fix polarity for LC and SC connectors shall be provided. The cable assembly manufacturer shall be ISO 9001 Certified. All patch cords shall be temperature rate to that of the cable requirements.

All patch cords for shall be single mode, four (4) fibers per patch cord, SC (at patch panel) and LC (at the Ethernet switch) connected, with a minimum length of ten feet (10') and maximum length as required.

1021-7.6 Fiber Optic Patch Panel:

1021-7.6.1 Fiber Optic Preterminated Patch Panel:

a. **Fiber Optic Preterminated Patch Panel 12F SC Duplex Single-Mode:** The Preterminated Patch Panel in conjunction with a drop cable serves as the attachment point from the controller cabinet to the trunk cable.

The Fiber Optic Preterminated Patch Panel shall be comprised of a factory terminated housing and a length of drop cable. The Patch Panel shall be an epoxy filled ABS Plastic housing with nominal dimensions of 10.4" long, 1.5" wide and overall depth of 1.4" from coupler tip to the base of the unit. The Patch Panel shall have six duplex SC SM couplers with ceramic inserts vertically arrayed along the length of the housing. The couplers shall be configured in a stair-stepped arrangement to facilitate easy access to each coupler pair. Each coupler port shall have a label affixed to designate the port number. The connectors on the inside of the housing shall be factory terminated to a PC finish (> -40dB) with a maximum insertion loss of 0.40dB. The inside of the housing shall be filled with an epoxy to permanently secure the connectors and the cable on the inside of the housing. The housing shall incorporate a 2.5-inch strain relief boot around the exiting drop cable to provide bend radius protection. The housing shall have integrated mounting notches for field mounting.

Each Preterminated Patch Panel shall be provided with factory test results for back reflection and insertion loss. This test report shall reference the serial number of the patch panel. The test report shall be provided to the Traffic Engineering Division or a designated Project Engineer after installation. Preterminated Patch Panel shall be Fiber Connections Gator Patch GP2J012FN-Bxx (xx represents length of cable or approved equal.

1021-7.6.2 Fiber Optic Connection Patch Panel, Outdoor:
Fiber optic connection patch panel, outdoor, shall be manufactured and constructed in accordance with the plans, these specifications, and as directed by the engineer.

All equipment shall be new and constructed using the highest quality, commercially available components and techniques to assure high reliability and minimum maintenance. The contractor shall submit, prior to installation, a complete set of shop drawings of all the equipment and components listed below and included as part of the installation.

The component of the patch panel described by this specification shall consist of the following:
Patch Panel

Shop drawings detailing the patch panel and appurtenances shall be submitted to the engineer for review and acceptance. The patch panel in conjunction with a drop cable serves as the attachment point from the communications device (i.e. ethernet switch, fiber transceiver, etc.) to the fiber optic trunk cable.

The patch panel shall be comprised of a closet connector housing and panel for terminating the fiber. The closet connector housing shall accept the fiber drop cable, allow for tie downs, fiber break outs, splicing, fanouts, cross connects, and patching panel for terminations for a minimum of 12 fibers per panel. The housing shall be wall or rack mountable. The housing shall be constructed of a black metal housing.

The panel shall be of the same manufacturer as the connector housing. The panel shall connect to the housing

using two simple snap connectors. The panel shall be type SC, LC or ST based on the communications equipment to be connected. The panel shall be free from debris, dust, or any material that could interfere with the fiber connection. Each connection point on the panel shall be sealed using a dust cap.

1021-7.7 Splice Closure and Splice Tray

Splice closures shall be used for through, branch or drop splice locations, underground as noted on the plans. All fiber splice locations shall be approved prior to installation and shall only occur at locations shown on the plans unless approved otherwise.

Three sizes of splice closures are possible.

- Type I splice closure shall have capacity of up to forty-eight (48) single fiber splices in four (4), twelve (12) fiber splice trays.
- Type II splice closure shall have a capacity of up to 144 single fiber splices in four (4) thirty-six (36) fiber splice trays.
- Type III splice closure shall have a capacity of up to 288 single fiber splices in eight (8) thirty-six (36) fiber splice trays.

All closures sizes shall accommodate a minimum of six (6) cable entries in one end.

Type of splice closures to be installed shall be a Type II unless specified otherwise on the plans.

The closure shall be comprised of two end plates and two glass-filled high-density thermoplastic shells. The thermoplastic shells shall have a permanently installed neoprene gasket and shall not require any additional material for re-entry. The closing hardware shall be captive to the top shell. The torquing sequence shall be molded into the shells. The top shell shall have a factory installed air valve port.

One end plate shall have six pre-molded cable ports in a three-section configuration; the opposite end plate shall be solid. The three section end plate shall have four entry ports that will accommodate up to a 7/8-inch cable and two entry ports that will accommodate up to a 3/4-inch cable. Weather resistant urethane grommets shall be available for both the 3/4- and 7/8-inch ports to allow the installation of smaller diameter drop cables and shall have a minimum of 3 cable entries. These grommets shall be used for any drop cable entry (cable diameter 0.27”-0.31”). The end cap shall provide individual central member tie off points and achieve a watertight seal without the use of sealing washers. End plates shall have accommodations for external grounding of shielded cables. All exposed metal on the closure shall be machined stainless steel.

The Type I closure shall have a minimum nominal diameter of six inch (6”) and a minimum nominal length of seventeen inch (17”).
The Type II closure shall have a minimum nominal diameter of six inch (6”) and a minimum nominal length of twenty-two inch (22”).
The Type III closure shall have a minimum nominal diameter of eight and one-half inch (8.5”) and a minimum nominal length of twenty-two inch (22”).

The end plates for the Type I, II and III closures shall be interchangeable. The closure shall require no special tools; drill kits, torches or power supplies for assembly, reentry or additional cable entries. The closure shall be suitable for handhold or buried applications. The closure shall be tested in accordance with GR-771-core, meet all requirements therein, and shall have test data demonstrating compliance. The closure shall not require encapsulation. The closure shall be provided with plugs for unused ports. The closure shall be provisioned with a storage compartment kit for loose tube mid-span splicing applications. (Preformed Line Products Pup 8006622 & Coyote Closures 8006560/8006561, Corning SCF Closures or approved equal.)

a. **Fiber Optic Splice Tray 36 Fiber:** The splice tray shall be used in conjunction with the splice enclosure, shall be from the same manufacturer, and shall be fully compatible with the splice

enclosure supplied. The splice tray shall be of molded thermoplastic construction with a clear plastic hinged cover. The splice tray shall have removable tabs around the perimeter of the fiber compartment for fiber routing. Each splice tray shall include tie wraps, felt strips, and a labeling device. The twelve (12), twenty-four (24) and thirty-six (36) fiber splice tray dimensions shall be compatible with Preformed Line Products 80806033 & 80805110, Corning SCF-ST or approved equal)

Splice trays, heat shrink protection sleeves and ancillary materials necessary to complete construction per the plans shall be considered incidental to the splice closure.

All optical fiber splices shall be fusion spliced. Splices shall be made with a fusion splicing machine capable of active fiber alignment via Local injection/detection or PAS. Maximum splice loss allowable shall be 0.10 dB per splice.

Splices shall be protected using an industry standard 60mm heat shrink protection sleeve incorporating a stainless steel rod. Protection sleeves shall be shrunk using a heat-shrink oven; no open flame, heat gun or other device shall be used.

b. **Splice Closure Installation:** The Contractor shall follow the manufactures recommended procedures for closure installation. Unless detailed in the plans, all non-endpoint splices are to be made using mid-span access techniques. Only fibers to be spliced shall be cut, remaining fibers occupying the same buffer tube shall be stored uncut in the splice tray. Un-cut buffer tubes shall be stored in the closure in an orderly manner and be accessible for future splicing operations. If a prescribed buffer tube length for mid-span splicing is not recommended by the manufacture, two times the recommended strip length for through splices shall be stored in the closure. For mid-span splice locations, the trunk cable shall enter the two outside lower ports on the closure; the drop cable shall enter the middle port through one of the three available grommet entry ports.

   All buffer tubes shall be labeled within two inch (2") of the splice tray using a permanent marker or wrap around write-on labels. Labels shall designate route of the fiber (for example, "trunk north", "drop cable", etc.). In addition, all splices in splice trays shall be labeled using the scheme supplied by the manufacturer of the splice tray. The labeling on the tray shall designate left side fiber/tube/cable and right side fiber/tube/cable. After splicing operations are complete, a flexible sealant (RTV) is to be applied to the heat shrinks. A clear plastic film shall be used to cover the sealant and heat shrinks to keep the sealant from making contact with fibers or the splice tray cover. A calibrated torque wrench shall be used for final assembly of the splice closure. Flash test per the manufacturers recommended method.

1021-7.8 Ethernet Switch:

1021-7.8.1 Local Ethernet Switch:

Field Hardened Gigabit Ethernet Switch: These specifications are for a Field Hardened Gigabit Ethernet Switch to be used in harsh environments, such as those experienced in traffic control cabinets.

The environmental guidelines given in this specification have been taken from the following standards:

- NEMA TS 2 1998 (Section 2.2.8)
- IEC 61850-3 (2002)
- IEEE P1613.

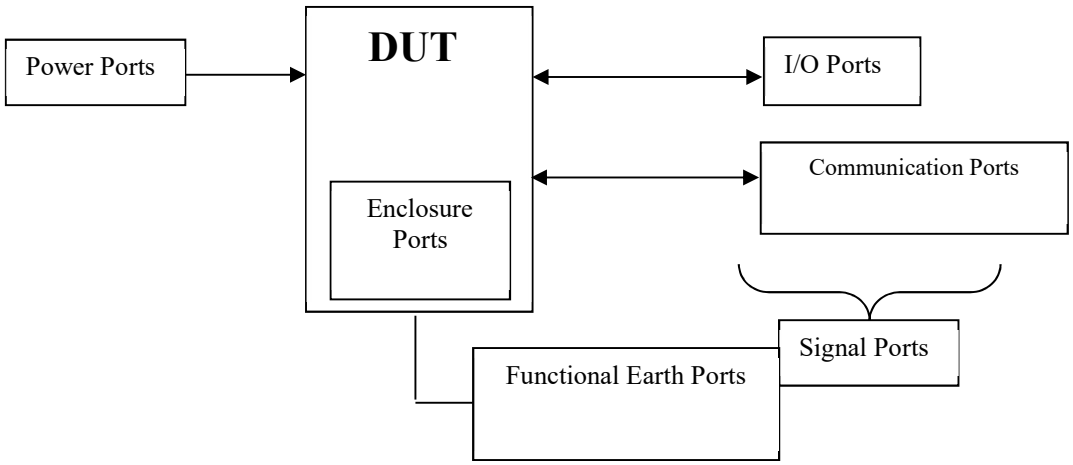
Definitions

Ethernet Switch: An intelligent hub device which learns the addresses of all connected devices on all ports and switches Ethernet frames accordingly to the appropriate port.

DUT: "Device Under Test" will refer to either an Ethernet Hub or Ethernet Switch.

Port: A specific interface of the DUT with the external electromagnetic environment (see Figure 1)

Figure 1: Port Types



Power Port: Port for the power supplied to the DUT.

Signal Port: Port for I/O (input/output) connections or communications connections to the DUT.

Enclosure Port: Physical boundary of the DUT through which EMI fields may radiate or impinge on. Functional Earth Port: Cable port intended for connection to earth for purposes other than electrical safety.

Immunity to EMI and Electrical Transients

IEC 61850-3 EMI Immunity Requirements: The DUT shall comply with the EMI immunity related type tests specified in IEC 61850-3 and summarized below in Table 1.

Table 1: IEC 61850-3 EMI Immunity

IEC 61850-3 (61000-6-5) Communications Networks and Systems In Substations (Jan 2002)				
TEST	Description		Test Levels	Severity Levels
IEC 61000-4-2	ESD	Enclosure Contact	+/- 6kV	3
		Enclosure Air	+/- 8kV	3
IEC 61000-4-3	Radiated RFI	Enclosure ports	10 V/m	3
IEC 61000-4-4	Burst (Fast Transient)	Signal ports	+/- 4kV @ 2.5kHz	x
		D.C. Power ports	+/- 4kV	4
		A.C. Power ports	+/- 4kV	4
		Earth ground ports[3]	+/- 4kV	4
IEC 61000-4-5	Surge	Signal ports	+/- 4kV line-to-earth, +/- 2kV line-to-line	4
		D.C. Power ports	+/- 2kV line-to-earth, +/- 1kV line-to-line	3
		A.C. Power ports	+/- 4kV line-to-earth, +/- 2kV line-to-line	4
IEC 61000-4-6	Induced (Conducted) RFI	Signal ports	10V	3
		D.C Power ports	10V	3
		A.C. Power ports	10V	3
		Earth ground ports[3]	10V	3
IEC 61000-4-8	Magnetic Field	Enclosure ports	40 A/m continuous, 1000 A/m for 1 s	N/A
IEC 61000-4-29	Voltage Dips & Interrupts	D.C. Power ports	30% for 0.1s, 60% for 0.1s, 100% for 0.05s	N/A
		A.C. Power ports	30% for 1 period, 60% for 50 periods	N/A
IEC 61000-4-11			100% for 5 periods, 100% for 50 periods[2]	N/A
IEC 61000-4-12	Damped Oscillatory	Signal ports	2.5kV common, 1kV differential mode @ 1MH	3
		D.C. Power ports	2.5kV common, 1kV differential mode @ 1MH	3
		A.C. Power ports	2.5kV common, 1kV differential mode @ 1MH	3
IEC 61000-4-16	Mains Frequency Voltage	Signal ports	30V Continous, 300V for 1s	4
		D.C. Power ports	30V Continous, 300V for 1s	4
IEC 61000-4-17	Ripple on D.C. Power Supply	D.C. Power ports	10%	3

Operating Frequency: The operating frequency range of the DUT input operating voltage shall be 60Hz ± 3.0Hz

Power Interruption: During and after the test the DUT shall be monitored and examined for any signs of arcing or flash over. Evidence of either arcing or flash over constitutes a failure.

Upon re-application of nominal power to the power ports the DUT shall be considered to have passed if it can perform its communications functions with none of the following occurring:

- Communications errors (i.e. frame loss or frame errors)
- Communications interruptions or delays (other than the maximum latency times specified by the manufacturer)
- Device latch-up requiring reset (manual or self applied)
- Any visible device damage.

Vibration: The DUT shall comply with the following standard for vibration immunity NEMA TS 2 1998 latest version.

- Vibration in each of the 3 mutually perpendicular planes
- Vibration frequency sweep of 5 to 30 Hz
- Vibration strength = 0.5g
- Duration = 3 hours, 1 hour at each plane

Upon completion of the vibration test the DUT shall be considered to have passed if:

- Upon careful examination there are no signs of physical damage.
- Upon the application of power the unit functions according to the manufacturer's specifications.

Shock (Impact): The DUT shall comply with the following standard for shock immunity NEMA TS 2 1998 (Section 2.2.9):

- Shock of no less than 10g in each of the 3 mutually perpendicular planes.

Upon completion of the shock test the DUT shall be considered to have passed if:

- Upon careful examination there are no signs of physical damage.
- Upon the application of power the unit functions according to the manufacturer's specifications.

Ethernet Network Standard Specifications: Ethernet is a technology that has evolved with heavy influence from the IEEE. IEEE specification exists for many aspects of an Ethernet switch. Ethernet switches should comply with the following IEEE standards as a minimum.

- IEEE-802.1D standard for media access control (MAC) bridges used with the Spanning Tree Protocol (STP);
- IEEE-802.1W (RSTP) Rapid spanning tree protocol
- IEEE 802.1Q standard for port-based virtual local area networks (VLAN);
- IEEE 802.1p message prioritization
- IEEE 802.3 standard for local area network (LAN) and metropolitan area network (MAN) access and physical layer specifications;
- IEEE 802.3u supplement standard regarding 100BaseTX/100BaseFX
- IEEE-802.3x standard regarding flow control with full duplex operation.
- IEEE-802.3Z Gigabit Standard (for switches with GB ports only)

Performance Specifications

Optical Port Specifications: All fiber optic link ports shall be capable of Multi-mode or Single mode. Single mode optics shall adhere to the following: Medium haul (40km) single mode fiber -5…-0 dBm for, Rx sensitivity -31 dBm. The optical ports shall be Type LC. The switch shall have minimum of two optical Gigabit ports that are capable of transmitting data at a minimum of 1000 Mbps.

Ethernet Switch Type 1 shall have a minimum of two (2) optical ports. Ethernet Switch Type 2 shall have a minimum of four (4) optical ports.

Copper Port Specifications: All copper ports shall be Type RJ-45 and shall autonegotiate for speed (i.e., 10/100Base), duplexity (i.e., full or half) and polarity. All 10/100BaseTX ports shall meet the Category 5 specifications and shall be compliant with the EIA/TIA-568-A standard pinouts.

The switch shall have the ability to support the Layer 2+ management features. These features shall include, but not be limited to:

- The STP healing rate shall meet or exceed specifications published in the IEEE 802.1D standard;
- The RSTP healing rate shall meet or exceed specifications published in the IEEE 802.1W standard;
- The switch shall support port-based VLAN's that meet or exceeds specifications as published in the IEEE 802.1Q standard;
- The forwarding/filtering rate shall be 14,880 packets per second (PPS) for 10 Mbps and 148,800 PPS for 100 Mbps and 1,488,000 for 1000 Mbps;
- The switch shall be able to support 2000 MAC addresses;
- The switch shall support, at a minimum, Version 2 of the Internet Group Management Protocol (IGMP);
- The switch shall include the electronics required for the Simple Network Management Protocol (SNMP V2). The switch shall be accessed using the resident EIA-232 management port, a telecommunication network, or the File Transfer Protocol (TFTP);
- The switch shall support management via Telnet and Web ;
- The switch shall support the TFTP, the Network Time Protocol (NTP), and the Simple Network Time Protocol (SNTP);
- The switch shall support Port Rate Limiting;
- The switch shall include integrated AC power supply

Warranty: The Local Ethernet switch shall come with a minimum 5-year warranty.

The Local Ethernet Switch with two to four Fiber Ports shall be Siemens RUGGEDCOM RS 900G or approved equal.
The Local Ethernet Switch with five or more Fiber Ports shall be Siemens RUGGEDCOM RS 916P or approved equal and is a Power over Ethernet switch. The number of fiber ports to be provided as indicated on plans.

1021-7.8.2 Local Wireless Managed Ethernet Switch and Antenna: The Local Ethernet Switch shall be Ruggedcom RX1400, Wireless Managed Ethernet Switch or approved equal and accessories. The switch shall include power supply, cellular router, antenna, external cabinet antenna, and antenna cable.

1021-7.8.3 Gigabit Ethernet Aggregation Switch:

LAYER 2 ETHERNET SWITCH:

a. **General Requirements:** The Ethernet network shall be comprised of an environmentally hardened Ethernet switching hub (i.e. Ethernet switch), herein referred to as a 'switch', compliant with IEEE 802.3 (10Mbps), IEEE 802.3u (100Mbps) IEEE 802.3z (1000BaseLX)), IEEE 802.1ab (1000BaseTX), and 10 Gig Ethernet. The switch shall allow the Ethernet ports to provide Power over Ethernet (POE).

b. **Support:** The switch shall come with free software images for the life of the product. The switch shall come with free phone and email support for life. The product including software shall be supported for 10 years following the announcement of end of life.

c. **Operating Environment:** The switch shall be capable of operating properly over an ambient temperature range of -40°C to +85°C without the use of internal or external cooling fans in accordance with IEC 60068-2-1 and 60068-2-2. The switch shall be capable of operating properly in relative humidity conditions of 95% non-condensing at 55°C in accordance with IEC 60068-2-30. The switch shall meet the requirements for Hazardous Location Certification: Class 1 div 2. The switch shall meet the environmental requirements of traffic control equipment in accordance with NEMA TS 2 (1998), Section 2: Environmental Requirements. Specifically NEMA TS 2 1998 (Section 2.2.8)

    1. Vibration in each of the 3 mutually perpendicular planes.
    2. Vibration frequency sweep of 5 to 30 Hz
    3. Vibration strength = 0.5g
    4. Duration = 3 hours, 1 hour at each plane
    5. IEC 61000-6-2 electrostatic discharge (ESD)
    6. IEC 61000-6-3 electromagnetic field
    7. IEC 61000-6-4 fast transients (burst)
    8. IEC 61000-6-5 surge voltage
    9. IEC 61000-6-6 induced (conducted) rfi
    10. IEC 61000-6-8 magnetic field
    11. IEC 61000-6-10 damped oscillating magnetic field
    12. IEC 61000-6-11 voltage dips and interrupts
    13. IEC 61000-6-16 mains frequency voltage

    The manufacturer shall provide evidence of independent testing verifying that performance. In general, the switch shall comply with the environmental requirements outlined in Environmental Requirements – Table 1. The switch shall be capable of operating properly when exposed to radiated electric fields of up to 10V/m continuously and magnetic fields of up to

40A/m continuously. In general, the switch shall comply with the EMI Immunity requirements given in IEC 61850-3 and IEEE P1613 (draft standard).

d. **Port Requirements:** The switch shall be field modular and have the ability add or replace modules in the field. The switch shall have a total of 28 ports 4 10 Gig ports 24 ports supporting 10/100/1000 Base-T, 24 ports 100Base-FX (100 Mbps) fiber optic or 24 ports 1000base X or a combination of 100Base-FX and 10/100/1000 and 1000 base-X up to 24 ports. The 4 10Gig ports shall have the ability to accept 1000Base-X SFP optics in addition to the 10Gig ports support fiber at 1310 nm or Single Mode at 1550nm SM fiber or 10/100/1000 Tx RJ-45 copper Ethernet. Single mode Gigabit optics should support distances up to 70km.

1. 10/100/1000BaseTX ports:
    i. RJ45 connectors
    ii. Cable type: Category 5, unshielded twisted pair (CAT 5 UTP)
    iii. Segment Length: 100m
    iv. Auto-negotiation support (10/100Mbps)
    v. Auto MDIX crossover capability.
    vi. Auto MDIX crossover capability
    vii. Full Duplex operation (IEEE 802.3x)
    viii. TVS (Transient voltage suppression) between Line +/-, Line +/-ground, to protect the circuitry
2. 1000BaseFX fiber optical ports (12):
    i. LC, SC, ST Connectors (single-mode)
    ii. Optical Characteristics: 1310 nm single-mode for distances of 10km and 25km.
    iii. Optical characteristics of 1550nm single-mode for distance of 40km and 70km.
    iv. Supports Fiber Type: 8/125 um or 9/125 um single-mode fiber
    v. Optical Budget single-mode fiber: minimum 17dB @ 1310nm, 21dB @ 1550 nm
    vi. Full Duplex operation (IEEE 802.3x)
3. 10/100/1000 PoE RJ45 ports (12):
    i. RJ45 connectors
    ii. IEEE 802.3ab – 1000BaseTX support
    iii. Cable type: Category 5, unshielded twisted pair (CAT 5 UTP)
    iv. IEEE 802.z
    v. Segment Length: 100m
    vi. Auto-negotiation support (10/100Mbps)
    vii. Auto MDIX crossover capability
    viii. Full Duplex operation (IEEE 802.3x)
    ix. TVS (Transient voltage suppression) between Line +/-, Line +/-ground, to protect the circuitry
    x. Power-over-Ethernet support (IEEE 802.3bt draft) for up to 24 ports 10/100/1000TX of POE ++ (60 Watts) to support 24 devices with a combined power of 500 Watts.

e. **Networking Requirements:** The switch shall support automatic address learning of up to 16384 MAC addresses. The switch shall support the following advanced layer 2 functions:

1. IEEE 802.1Q VLAN, with support for up to 255 VLANs and 4096 VLAN ID's.
2. IEEE 802.1.Q-in-Q support
3. IEEE 802.1p priority queuing
4. IEEE 802.1d
5. IEEE 802.1 AB 2005 LLDP
6. IEEE802.1Q-2005 MSTP (formerly 802.1s)
7. IEEE 802.1d 2004D RSTP and eRSTP
8. IEC 62439-2 Media Redundancy Protocol MRP

9. IEEE 802.1ad – Link aggregation
10. IEEE 802.3x flow control
11. IGMPv3 with 256 IGMP groups
12. Mac address table size 2000 Kbytes
13. DHCP Option 82
14. Port Rate Limiting
15. Configuration via text file which can be modified through standard text editor
16. Switching Latency 3usec or less
17. Switching Bandwidth 128 GigBits/sec
18. IEEE 1588 Transparent clock
19. USB interface which enables easy in field configuration and upgrading

f. **Network Management Functionality Requirements:** The switch shall provide the following network management functions:
1. SNMPv2, SNMPv3
2. RMON
3. GVRP
4. GMRP
5. Port Mirroring
6. 802.1x port security
7. SSL – Secure Socket Layer
8. SSH – Secure Shell
9. TFTP
10. Network Time Protocol (NTP)
11. Simple Network Time Protocol (SNTP) Master Client
12. Management via Telnet or Web
13. Radius
14. TACACS+
15. Cable diagnostics (test-mode).

Built in Protocol Analyzer which enables traces to be run from within the switch operating system. Must be able to forward traces to an IP address or UDP port. Traces for must include but not be limited to the following: STP, MAC, Link, IGMP, GVRP, PPP, Transport, DHCPRA, 802.1X, WEBS, SNMP, IP, TACACS+, Radius, FORW, IPASSIGN, TRANSPORT.

Additionally, the switch shall demonstrate to provide sub 1ms failover per switch hop in a ring topology.

Option to conformal coating.

g. **Programmable Critical Failure Relay:** The switch shall provide a programmable critical failure out relay that may be configured to activate upon critical error detection such as loss of link or detection of critical system errors. This function shall be user enabled and programmable. The output contacts shall be available in a Form-C configuration and be capable of switching at least 30Vdc @ 2A.

h. **Power Supply Requirements:** The switch shall be supplied with provisions for operation at the following power supply inputs; 85 VAC to 264VAC(50/60Hz)/88VDC 300VDC auto sensing. The switch shall support optional dual redundant, load sharing power supplies. The power supply shall be internal to the switch. Power supply shall have two stage isolation accomplished via two transformers which step down from primary AC/DC to VDC. A power cord of not less than 5 feet in length shall be supplied as well. The switch shall require no more than 120W of power.

i. **'Hipot' Testing in the Field:** The switch shall allow for dielectric strength ('hipot') tests in the field, in accordance with IEC 60255-5, by trained personnel. It shall be capable of enduring a test voltage of at least 2kVrms on power supply inputs above 60V and 0.5kVrms on power supply inputs below 60V. A removable grounding wire shall be provided to allow disconnecting of any transient suppression circuitry at the power supply input to allow for 'hipot' testing without activating the transient suppression circuitry.

j. **Mounting Requirements:** The switch shall provide options for DIN Rail, Panel or rack mounting via brackets. The switch shall require no more than 1RU of rack space.

k. **Warranty:** The Switch shall be warranted for defects in material and workmanship for five (5) years after shipment. The Warranty shall include software updates, 7x24 phone support and repair/replacement for the 5-year warranty period with an option of extending to 8 years.

l. **Environmental Requirements:**
Ingress Protection: IP40 (1mm objects)
The switch shall comply with the atmospheric, vibration, shock and bump requirements outlined in Table 1. This compliance shall be demonstrated by type withstands tests (i.e. 'type tests') as outlined in Table 1 and summarized in a Type Test Report per the test report requirements of each of the standards given in Table 1.

m. **Safety Requirements / Agency Approvals:** The switch shall comply with the following electrical safety requirements or equivalents: UL60950 or CSA C22.2 No. 60950 (safety requirements for IT equipment). The switch shall also have CE (Europe) qualification. The switch shall also comply with FCC Part15 Class A for EMI emissions.

n. **Small Form-Factor Port Module (SFP) (included with ITS Cabinet):** The Switch shall include 4 SFP modules. They shall be 10Gig modules. Two SFP modules shall have a minimum reach of 10 km and two SFP modules shall have a minimum length of 40 km. These modules shall have an operational temperature range of 0 to 70°C (32 to 158°F).

The Gigabit Ethernet Aggregation Switch shall be Siemens RUGGEDCOM RST 2228P or approved equal and is a Power over Ethernet switch.

1021-7.9 ITS HUB CABINET

a. **General:** The ITS HUB Cabinet is a Cabinet Assembly designed for housing a variety of ITS equipment and network devices including, but not limited to, managed field Ethernet switches, hub switches, device servers, digital video encoders, fiber optic cable patch panels, and equipment racks for non-intrusive vehicle detection systems. The ITS HUB Cabinet shall include a battery backup unit, batteries, and a Network Switch as outlined below.

b. **Cabinet Shell:** The Cabinet Shell shall conform to all of the NEMA 3R requirements for cabinet enclosures.

The Cabinet Shell shall be constructed using unpainted sheet aluminum alloy 5052-H32 with a minimum thickness of 0.125".

The ITS Hub Cabinet Shell dimensions shall be as follows, unless otherwise approved by EBR Traffic Engineering Division:
Height Width Depth

66” 24” 30”

The Small ITS Hub Cabinet Shell dimensions shall be as follows, unless otherwise approved by EBR Traffic Engineering Division:

Height	Width	Depth
44”	24”	22”

The Cabinet Shell shall be built in a manner so as to ensure that it is completely weather resistant. The top of the Cabinet Shell shall be crowned in order to prevent the presence of standing water.

The Cabinet Shell shall be furnished with (2) lifting eye plates on either side of the cabinet. Each lifting eye shall have a minimum diameter of 0.75” and have the ability to support the weight load of 1,000 lbs. External bolt heads shall be tamperproof.

Supply the Cabinet Shell with front and rear doors furnished with locks that accept #2 Corbin keys (two keys provided per lock) and handles. The doors shall be held by (3) 14-gauge stainless steel hinges that are mounted so that they are only removable when the cabinet door is opened. Door openings shall be double flanged on all four sides. A closed-cell neoprene gasket seal shall be placed around the inside edges of each door to create a weatherproof seal when the door is closed.

A three-point latching system shall be attached to each door. Latching points shall be provided at the center of the cabinet doors (door lock) as well as the top and bottom of the cabinet doors. The latching points at the top and bottom of the cabinet doors shall be controlled by the door handles and have nylon rollers to secure the top and bottom of the door when the door is closed.

A door stop shall be supplied that will hold the main door open in a 90° and 120° position.

A heavy-duty re-sealable plastic bag shall be mounted on the back of the front door of the cabinet for storage of cabinet prints and other relevant documentation for the Cabinet Assembly.

c. **Ventilation:** Louvered vents shall be provided at the bottom of the front and rear doors of the cabinet, the depth of which shall not exceed 0.25”. The vents shall be weatherproof through the use of water deflecting ventilation shells that shall be on the inside of both doors. The ventilation shells form a protective barrier over the 12” x 16” reusable filters, and are louvered to direct incoming air towards the bottom of the Cabinet Assembly. Both the ventilation shells and reusable filters shall be held in place by a bottom trough and a spring-loaded upper clamp.

d. **Racks:** Each Cabinet Assembly shall include a standard 19” EIA equipment rack with a clearance of 17.75” between the rails. This rack shall be utilized for mounting various equipment within the Cabinet Assembly.

e. **Shelf:** A level, rollout internal shelf with a storage compartment shall be provided with each Cabinet Assembly. The shelf shall approximately provide a 16”x14” working area and have the ability to bear a constant 25 lb. burden. A non-slip plastic laminate shall be attached to the top of the shelf that covers at least 90% of the surface area.

f. **Electrical Requirements:** All wiring in the Cabinet Assembly shall conform to NEC specifications. Wire used shall only be stranded copper and shall be laced for tidiness.

g. **Cabinet Light and Fan:** Dual thermostatically controlled electric fans (100 CFM) shall be supplied at the top of the Cabinet Assembly. The electric fan motors shall have ball bearings.

Exhaust air from the fans shall be vented outside of the Cabinet Assembly through openings in the roof of the Cabinet Shell.

The thermostat is to be mounted on the inside top of the Cabinet Assembly and shall be easily accessible for technician modification and maintenance. The thermostat shall activate the fans within ± 3°F of the set temperature and allow for temperature settings between 70°F and 160°F.

The Cabinet Assembly shall be equipped with (2) 20-watt fluorescent lights protected by clear shatter-proof shields. The lights shall be mounted on the inside front and rear top of the Cabinet Assembly. Door actuated switches shall be provided that will turn the lights on automatically when either cabinet door is opened, and turn the lights off when the doors are closed.

h. **Terminal Blocks:** Terminal blocks shall have a voltage and current rating greater than the voltage and current rating of the wire that is terminated to the specific terminal block. Wires shall be terminated on terminal blocks using insulated lugs that are large enough to house the wire that is being terminated. Terminal ring lugs shall be used on terminal block screws where two or more wires are terminated. All terminal block circuits shall be numbered and covered using a clear insulator to prevent accidental contact by a technician.

i. **Ground Bus Bar:** Ground Bus bars shall be constructed of a copper alloy material compatible with copper wire. Copper Bus bars shall have at least two (2) positions where a #6 AWG stranded copper wire can be terminated. The ground bus bars shall be mounted on the side of the cabinet wall adjacent to the Service Panel Assembly for the connection of AC neutral wires and chassis ground wires. If more than one (1) copper bus bar is used in a cabinet, a minimum of a 10 AWG copper wire shall be used to interconnect the two. The equipment rack shall be connected to the ground bus bar within the cabinet maintaining electrical continuity throughout the cabinet.

j. **Service Panel Assembly:** Provide a Service Panel Assembly to serve as the entry point for AC power to the Cabinet Assembly. The Service Panel Assembly shall also serve as the location for power filtering, transient suppression and equipment grounding. Branch circuits, SPD and grounding as required for the load served by the Cabinet Assembly shall be included on the Service Panel Assembly. The SPD shall be accessible from the front of the panel and be connected for the Cabinet Assembly's main AC power input on the load side of the main power circuit breaker.

k. **Power Distribution Assembly:** A Power Distribution Assembly that provides for the protection and distribution of 120 VAC power shall be provided within the Cabinet Assembly. The Power Distribution Assembly shall fit in the 19" EIA rack. Three (3) circuit breakers shall be supplied on the Power Distribution Assembly; One (1) 30A circuit breaker (MAIN Power) and two (2) 15A circuit breakers (ACC Power and EQU Power). The Power Distribution Assembly shall also contain one (1) Ground Fault Interrupted Duplex receptacle (ACC) and (2) standard equipment duplex receptacles (EQU).

Layer 2 Networking Switch (included with ITS Cabinet):

1021-7.9.1 ITS Hub Cabinet Battery Back-Up

a. **General:** This specification establishes the minimum requirements for a complete emergency battery backup system for use at traffic signals utilizing Light Emitting Diode (LED) signal heads; blank out no turn signs, and pedestrian signal heads. The Battery Back-up System (BBS) shall include, but not be limited to the following:
   1. Integrated Power Transfer Switch
   2. Batteries

3. Inverter/Charger
4. Mounting hardware
5. Wiring

The BBS shall provide emergency power to a traffic signal in the event of a power failure or interruption.

b. **Operation:**

1. **General:** The BBS shall provide the following operational modes when operating on battery power:
   i. Full operation of all traffic signal devices
   ii. Flash operation
   iii. Combination of full and flash operation

2. **Run Time:** The BBS shall be programmed to provide a minimum of 450 watts for 6.0 hours of full time operation for an ITS Field cabinet. The minimum battery size requirement is listed in section 7.1, Battery Type.

3. **Compatibility:** The BBS shall be compatible with all existing East Baton Rouge Parish and LADOTD cabinets (NEMA type TS1 and/or TS2) and controllers (TS2 Type 2 and/or ATC) and all cabinet components for full time operation.

4. **Output Capacity:** The BBS shall provide a minimum of 650W/650VA@25°C active output capacity with 80% minimum inverter efficiency with 30% loading.

5. **Output Voltage:** When operating in backup mode, The BBS output shall be 120VAC ± 5VAC, pure sine wave output, ≤3%THD, 60Hz ± 0.05 Hz. No square or stepped wave shapes are acceptable.

6. **DC System Voltage:** The BBS DC system voltage shall be 48VDC.

7. **Transfer Time:** The maximum transfer time allowed, from disruption of normal utility line voltage to stabilized inverter line voltage from batteries, shall be a maximum of 65 milliseconds (ms). The same maximum allowable time shall also apply when switching from the inverter line voltage to utility-line voltage. Transfers to and from battery operation shall not interfere with the operation of the other equipment in the intersection.

8. **Operating Temperature:** The BBS and all components shall operate without performance degradation over a temperature range of -37°C to +74°C. Additionally, all components and parts used shall, at the minimum, be rated for this temperature range.

9. **Feedback Level:** In the event the AC service feeding the BBS is severed, or there is a utility blackout, the AV voltage measured at the AC inputs to the BBS (line to neutral) shall be less than 1 VAC.

10. **Surge Protection:** The BBS shall have lightening surge protection compliant with IEEE/ANSI C.62.41 and must be able to withstand 2000 volt surges applied 50 times across line and neutral. These surges shall not cause the BBS to transfer to Backup mode.

11. **Power and Control Connections:** The BBS shall be easily installed, replaced, or removed by using easily removable cables for AC input, AC output, DC input, external transfer control and battery temperature sense.

i. **AC Connection:** The AC input and output shall be panel mounted plug/receptacles or hard wired connections that allow no possibility of accidental exposure to dangerous voltages. If utilizing plug/receptacles the AC Input shall be a male receptacle and the AC output shall be a female receptacle. The receptacles shall utilize some form of locking mechanism or hold down clamps that prevent accidental disconnects.

ii. **DC Connection:** The DC connection shall be a recessed one (1) or two (2) piece Anderson Style receptacle.

iii. **Relay/Temperature Probe Connections:** The Power Transfer relay control and the battery temperature sense inputs shall be heavy duty panel-mounted style connectors.

12. **General Connections:** All connections shall provide mechanically and electrically secure connections without the use of a screwdriver. The only exception is the Relay Terminal Block for alarms and the hardwired AC input and output terminals for the power connections.

13. **Unit Failure:** In the event of inverter/charger failure, battery failure or complete battery discharge, the power transfer switch shall revert to a Normally Closed (NC) (and de-energized) state, where utility line power is connected to the cabinet.

14. **Overload:** The BBS must be able to shut down in order to protect against internal damage in the event of an overload at the output.

15. **AC Feedback:** The BBS shall prevent a malfunction feedback to the cabinet or from feeding back to the utility service. In the event of BBS failure (inverter/charger or battery) or complete battery discharge, the power transfer relay shall revert to a Normally Closed (NC) (and de-energized) state where utility line power is connected to the cabinet.

16. **Automatic Shutdown:** The BBS shall initiate an automatic shutdown when battery output reaches 42VDC.

17. **Destructive Discharge or Overcharge:** The BBS shall be equipped with an integral system to prevent the battery from destructive discharge or overcharge.

c. **Power Transfer Switch:**

1. **Rating:** The BBS shall include a Power Transfer Switch rated at 120VAC/30 amps minimum.

2. **Manual Bypass Switch:** The Power Transfer Switch shall include a manual bypass switch. Placing the manual bypass switch in the "Bypass" mode shall transfer the intersection load from the Uninterruptible Power Supply (UPS) output directly to commercial power. An inverter input breaker shall be provided and located on the Bypass Switch so to shut off commercial power to the UPS input, allowing safely disconnecting and removing the inverter. With the inverter turned off, the batteries can be safely disconnected from the system.

3. **Indicator Light:** The Power Transfer Switch shall include a bypass indicator light that automatically notifies the user when the Manual bypass switch is in Bypass position. The indicator light may be illuminated when in UPS mode and off when in bypass mode.

4. **Status Relay:** The Power Transfer Switch shall include a bypass status relay with normally

open, contacts that automatically close when the Manual bypass switch is in Bypass position.

5. **Power Transfer Relay:** The Power Transfer Switch shall include a 30 Amp power transfer relay controlled by the inverter to cause the Power Transfer Switch to switch between AC power from the utility and battery power from the inverter.

6. **Integrated Switch:** The manual bypass switch and the power transfer relay shall be integrated together within the Power Transfer Switch allowing the manual bypass switch to be rated at 15 Amp and to be integrated with the bypass indicator light and bypass status relay.

7. **Terminal Block:** The Power Transfer Switch shall have terminal blocks capable of accepting #6 AWG wiring for the AC input with #10 AWG internal to the Power Transfer Switch as required for 30 Amp operations.

d. **Inverter/Charger Functionality:**

1. **Buck/Boost Mode:** The BBS shall include Buck/Boost Functionality.

   i. **Range:** The Buck/Boost Mode shall have a minimum range of 90-150 VAC.
   ii. **Regulated Voltage:** Whenever Buck/Boost Mode is selected the output of the system shall be regulated between 108-130 VAC. When the output of the system can no longer be maintained with this range, the BBS shall transfer to Backup Mode.

2. **Line Quality Time:** The BBS shall have a user definable line qualify time. The user shall be able to select a minimum of three (3) possible settings. The minimum setting shall be 3, 20, and 30 seconds. The default line qualify time shall be 3 or 30 seconds.

3. **Battery Charger:** The BBS shall have an integral charger. The charger shall be a 3-step charger using bulk, absorption and float charging techniques, appropriate for the battery type.

   i. **Temperature Compensation:** The integral 3-Step Charger shall use temperature compensation. The charging system shall compensate over a range of2.5-4.0 mV/°C per cell.
   ii. **Temperature Sensor:** A temperature probe which plugs into the front panel of the BBS shall be used to monitor the internal temperature of the batteries. The Temperature sensor shall be of sufficient length to properly reach the center battery and yet not too long to cause an inaccurate reading.
   iii. **Battery Temperature:** The batteries shall not be recharged whenever the battery temperature exceeds 50°C.
   iv. **Recharge Time:** The recharge time for the batteries from "protective low-cutoff' to 80 percent or more of full charge capacity shall not exceed twelve (12) hours.

e. **User Interfaces and Displays:**

1. **Inverter/Charger Display:** The BBS inverter/charger unit shall include a backlit LCD display for viewing all status and configuration information. The screen shall be easily viewable in both bright sunlight and in darkness.

   i. **Screen Size:** The screen shall be large enough to display the following information with the use of menu scrolling buttons to read required information:

A. Operating Mode (Standby, Buck/Boost)
B. Utility input voltage
C. BBS output voltage
D. Charger status
E. BBS Status (Standby, Backup, Buck/Boost)
F. Any alarms and faults

ii. **Relay Status Information Keypad:** The BBS inverter/charger unit shall include a keypad for configuring system parameters and navigating system information.

2. **Web-based Interface:** The BBS shall be provided with a web-based-interface for user configuration and management through a web browser.

   i. **Minimum Capabilities:** The BBS shall allow the user to do the following through the web browser:
      A. View Logs
      B. Change modes of operation
      C. Configure email alarms
      D. Adjust line qualify time
      E. Program relay contacts
      F. Configure network parameters

3. **Status LEDs:** The BBS shall have discrete status LED indications on the front of the inverter/charger.

   i. **Green Output LED:** This LED will be ON any time that the output of the BBS is in Normal Mode. When the output is modified, either by Backup Mode or by Buck/Boost Modes the LED will change state, color or blink Green.
   ii. **Red Fault LED:** This LED will be Full ON any time that there are any faults in the system.
   iii. **Yellow or Red Flashing Alarm LED:** The LED will be Full ON Yellow or Red Flashing any time that there are any alarms in the system.
   iv. **Event Log:** The BBS shall maintain an event log containing a minimum of 100 of the most recent events recorded by the BBS. At a minimum, the Event Log shall record the following:
      A. Date/Time Stamp
      B. Current operating mode
      C. What the event was

      These events shall be down loadable remotely via Ethernet. The Event Log shall be viewable through the LCD display, EIA-232 port, and the Ethernet Interfaces.
   v. Counters: The BBS shall keep track of the following:
      A. The number of times that the unit was in Backup, Buck and Boost Modes.
      B. The total number of hours and minutes that the unit has operated in those modes since the last reset.

4. **Programmable Relay Contacts:** The BBS shall provide the user six (6) programmable relay contacts. As a minimum, the programmable options shall be On Battery, Low Battery, Timer, Alarm, Fault, and Off.

   i. **Relay Contact Terminals:** The relay contacts shall be made available on the front panel of the BBS via an 18-position, screw hold-down, printed circuit board mounted terminal block.
   ii. **Contacts:** Each relay shall have their own common and their own set of Normally

Open (NO) and Normally Closed (NC) terminals. The terminals for each relay shall be oriented as NOC-NC on the terminal block.

iii. **Labeling:** The contacts on the terminal block shall be labeled 1-18, left to right. Additionally, each set of contacts shall be labeled with the NO-C-NC designation, as well as C1…C6 from left to right. All additional contacts on the terminal block shall be labeled as "spare".

iv. **Rating:** The relay contacts shall be rated at a minimum of 1 amp @125 VAC.

v. **Display:** When a relay is energized, it shall be displayed on the LCD screen.

vi. **On Battery Relay Contact:** The relay contacts that are configured for "on battery" shall only energize when the Inverter is operating in Backup Mode.

vii. **Timer Relay Contact:** The BBS shall include a timer that will energize the "timer" configured relay contact after the user configured time has elapsed. The timer is started when the BBS enters Backup Mode. The user shall be able to configure the timer from 0 - 480 minutes in 15 minute increments.

viii. **Low Battery Relay Contact:** The BBS shall have an adjustable low battery relay setting. This setting shall be adjustable so that the user can set the point at which the low battery relay contact is energized.

f. **Communications:**

1. **Serial Interface:** The BBS shall be equipped with an industry standard RS-232 serial connection for user configuration and management. The serial port shall be an EIA-232 (DB9-Female) connector.

2. **Ethernet Interface:** The BBS shall have an Ethernet communication interface for user configuration and management. The Ethernet Port shall be an RJ-45, EIA 568B Pin-Out Connector.

3. **Remote Monitoring:** The BBS shall include remote monitoring & alarms transmission capabilities. These should communicate through the Ethernet RJ45 IP Addressable Port, using SNMP protocol. Other means of communication will be considered.

4. **User Configurations Menus:** All BBS configuration and System menus shall be accessible and programmable from the RS- 232 and Ethernet Port.

5. **Communications Protocols:** The BBS shall support TCP and UDP over IP protocol communications.

6. **Application Layer Protocols:** The BBS shall support FTP, Telnet, and HTTP.

7. **SNMP (Simple Network Management Protocol):** The BBS shall be SNMP compliant.

g. **Batteries:**

1. **Battery Type:** The battery shall be comprised of extreme temperature, float cycle, GEL VRLA (Valve Regulated Lead Acid). Individual batteries shall meet the following specifications:

i. Voltage Rating: 12V

ii. Amp-hour Rating: 100 to 109AH, at the 20 hour rate, to 1.75 Volts per cell, minimum battery rating. Larger AH batteries are acceptable; however they must not exceed the Battery Council International (BCI) group size listed below.

iii. Group Size: BCI Case 31, maximum

Batteries shall be commercially available off the shelf. Batteries shall be replaceable without shutting down power to the entire intersection.

2. **Battery String:** The battery system shall consist of one (1) or more strings of extreme temperature, float cycle, GEL VRLA (Valve Regulated Lead Acid) batteries. Batteries used for the BBS shall consist of four (4) batteries configured for a 48 VDC battery buss system. Paralleling multiple strings in order to provide the supplied amp-hour requirements in this specification shall not be acceptable. It shall be an acceptable means for LADOTD to increase the available amp-hours as deemed necessary by paralleling battery banks.

3. **Operating Temperature:** Batteries shall be certified to operate at extreme temperatures from -40°C to +74°C.

4. **Construction:** Battery construction shall include heavy-duty, inter-cell connections for low-impedance between cells, and heavy-duty plates to withstand shock and vibration.

    i. **Top Cover:** The top cover shall use tongue and groove construction and shall be epoxied or heat-sealed to the battery case for maximum strength and durability.
    ii. **Ability to Function:** The battery shall be designed to function if laid on its side without leakage of chemicals. An integral lifting handle must be provided on the batteries for ease of removal/installation.

5. **Interconnect Wiring:** All batteries shall be provided with the appropriate interconnect wiring.

h. **Maintenance:**

1. **Probe Jacks:** The BBS shall provide voltmeter standard probe input-jacks (+) and (-) to read the exact battery voltage drop at the inverter input.

2. **Circuit Breakers:** The BBS shall be equipped with an AC input circuit breaker that protects both the UPS and the loads connected to the output. Should the AC input breaker feeding power to the UPS trip, it shall allow the UPS to go to inverter mode to power the intersection off of batteries. Should an overload condition still exist when the inverter is energized, the inverter will revert to its internal electronic protection, preventing damage to the inverter due to the overload or short circuit condition on the output. Once this overload condition is cleared the inverter will energize and power the intersection utilizing the available battery power. If the condition does not clear itself, the inverter will stay in the standby mode until manually cleared by a technician. An AC output breaker that would prevent the inverter from powering the load from batteries when tripped shall not be utilized.

3. **Accessibility:** All components, terminations, terminal blocks, relays, etc. shall be fully accessible.

1021-7.10 Wireless Radio Transceiver:

a. **Description:** This work consists of adding broadband radio communication capabilities to local traffic signal controller locations in lieu of hard wire interconnect, or fiber optic communications per the plans.

b. **Materials:** As required on the plans, each local intersection shall have a local transceiver, an antenna, brackets, cables, wiring, and hardware required for a complete, functional, and operational broadband radio transceiver. All equipment as specified herein for the broadband radio transceiver with required software, programming manuals, manufacture specifications, schematics, wire diagrams, and parts diagram shall be submitted to the Traffic Engineering Division for approval.

c. **Broadband Radio for Traffic Signal Controller Communications:** Communications between local intersections shall be performed via broadband radio. The radio signal communications shall be done in 5.8-GHz radio frequency (RF) based upon the contractor's radio terrain analysis, strength of signal, and availability of required bandwidth. No licensed requirements, type acceptance under FCC part 15.247.

d. **Broadband Connection:** The broadband radio transceiver shall use Orthogonal Frequency Division Multiplexing (OFDM) technology, providing long-range data transport up to 35 Mbps/108 Mbps data rates for 5.8-GHz radio frequency based, respectively. Each broadband access points shall continually scan the band for spectrum usage and seamlessly switch to the "clearest" RF channel to maintain maximum throughput and reliability. The broadband wireless systems shall continually monitor the RF link quality and automatically adjust the modulation and date rate to maximize link performance. The broadband systems shall be equipped with advanced security features including: WPA2, WPA, WEP, MAC Authentication, and Radius Server Authentication. The broadband system shall be 802.11 a/b/g compliant.

SPECIFICATIONS	900 MHZ	5.8 GHZ
Transmitter		
Output Power	28 dBm 700 mWatt	28 dBm 400 mWatt
Range, Line of Sight	20 Miles	20 Miles
Modulation	OFDM and/or DSSS	
Usable Data Rates	35 Mbps minimum	
Regulated Power Supply	Power over Ethernet with lightning and surge protection	
General Requirements		
Temperature Operating Environment (non-condensing)	-40º C to + 74º C	
Enclosure Requirements		
Separate transceiver and antenna required. (Integrated antenna/transceiver not accepted)	• Pole/wall mount • Dia cast aluminum • IP67 weatherproof rated	
Security Requirements		
	• AES-CCM Encryption • 64 bit, 128 bit WEP Encryption • WPA • WPA2 • TKIP • MAC/RADIUS Server authentication • EAP-tls/EAP-passthrough	
Networking Requirements		
	• Spanning Tree Protocol • SHCP Server or Client • NTP Network Time Protocol • Firewall and NAT • Routing • QOS • VPN • VLAN • SNMP • Bandwidth test tool	
Connectors/Signals		
Wireless Transceiver	N Type female	
Data	10/100 Base-T Ethernet (RJ 45) using Cat6 outdoor rated cable	

e. **Antenna:** The required antenna(s) shall be in accordance with the manufacture specification of the broadband transceiver. The antenna shall be Unidirectional (Yagi), Omni directional, or panel depending on the site location. Cable to the antenna shall be in accordance with the manufacturer of the broadband transceiver and tested prior to shipment. Antenna and cables shall match the frequency range of the transceiver. If antenna is to be located a distance greater than hundred feet (100') from the radio, an amplifier shall be provided.

f. **Short Range Point to Point Broadband Connection Incidentals:** Incidentals include but are not limited to cables, wires, filters, amplifiers, connectors, power supplies, brackets, repeaters, and hardware.

g. **Testing:** Testing shall include:

1. **Pre-construction:**
   i. Radio terrain analysis;
   ii. Verification of signal strength between the master location and the local (slave) location (900 MHz or 5.8 GHz);
   iii. Available bandwidth adequate for multiple streaming video transmissions and signal interconnect;
   iv. Verification of compatibility with traffic signal controller;
   v. Verification of equipment compatibility with fiber optic communication medium back to the central control system.

2. **Installed:**

   i. Connection of transceiver and antenna;
   ii. Integration of transceivers with fiber optic communications, signal controllers, and video detection cameras;
   iii. Verification of communication link between field locations; and
   iv. Integration with central signal control system;

All testing procedures shall be provided to the Traffic Engineering Division for approval prior to performing the test. Test results shall be provided to the Traffic Engineering Division for approval prior to acceptance of the installation.

h. **Warranty:** All equipment shall have a standard manufacturer's warranty of 1 year. The contractor shall provide service support and shall be responsible for any equipment failures due to faulty equipment as deemed by the Traffic Engineering Division.

i. **Measurement:** The Wireless Radio Transceiver will be measured per each installation site, complete in place and accepted. The Wireless Radio Transceiver includes furnishing all equipment, labor and other incidentals required to complete this item of work. Measurement for payment will include, but shall not be limited to the following items: wireless broadband transceiver, antenna, testing, installation and integration with signal controllers, integration with communications to the central traffic signal system, and all miscellaneous hardware required for a complete, functional, and operational broadband radio installation.

1021-8 INTEGRATION AND TESTING:

General: Communication for the traffic signal system shall provide for sending and receiving data from a dedicated computer in the ATM/EOC to and from the traffic signal controllers connected by the fiber allocation diagram and communication layout in the plans. Communication for the traffic signal system shall provide for the transmission of video to a dedicated computer in the ATM/EOC from the IP MPEG 4 video detection cameras connected by the fiber allocation diagram and communication layout in the plans. Traffic signal Ethernet ready controllers shall be directly interconnected. All programming and configuration required at the ATM/EOC on the signal controller management software and at the intersection traffic signal controller locations (including modifying dip strip settings) shall be provided by the contractor or a manufacturer's representative as part of integration. Testing shall include verifying operations at both the ATM/EOC and at the intersections.

The contractor shall be responsible for providing the installation of all equipment, software, firmware, etc. and configuration of all equipment in order to provide the require system described herein. The contractor shall submit a draft network diagram, proposed equipment configurations, and a draft test plan to the Chief Traffic Engineer for approval prior to commencing the work. Prior to acceptance of the project, the contractor shall

provide an AS BUILD network diagram that details the exact communication layout of all equipment installed including: Traffic Signal Controllers, Ethernet Switches, Serial to Ethernet Servers, and Video Detection Devices affected by this project. The AS BUILD shall show and label communication wiring, port used and ports available. A supplemental document shall accompany the AS BUILT diagram that details the network configuration of each device connected to the communication backbone as part of this project.

During the integration and testing, the contractor shall ensure that all signal controller data bases are developed and implemented in the ATM/EOC controller software and the communication (uploading/downloading of controller data and video images) is operating between field devices and the workstations located at the ATM/EOC.

Upon completion of the Integration and Testing, the completed system shall operate for a period of sixty (60) days without failure. This time period shall be referred to as the "Burn-In Period". The Burn-In Period must be approved by the Traffic Engineering Division prior to Final Acceptance. See City-Parish Specification 906 for additional information.

1021-9 EMERGENCY VEHICLE PREEMPTION SYSTEM:

a. **Description:** This item consists of furnishing all necessary equipment, labor and materials required to install GPS Based Emergency Vehicle Preemption at a signalized intersection in accordance with the plans and the following requirements. The system including all software, equipment, and components shall be fully compatible with the Emergency Vehicle Preemption System currently in use by the East Baton Rouge Parish Traffic Management Center (Glance Priority and Preemption System for AI) and shall provide the following key requirements:

   1. The system shall track emergency response vehicles and provide preemption and priority requests to the traffic signal controller.

   2. The system shall be fully functional and compatible with all existing traffic signal controller models (Trafficware ATC, and TS2} currently in use by the City-Parish.

   3. A web based configuration utility shall provide an easy way to program of preemption and priority zones.

   4. The system shall use the GPS position of the vehicle to determine when to send a preemption request to the traffic signal controller based on a user defined preemption and priority zones.

   5. The system shall be capable of configuring preemption and priority requests for more than 120 seconds before the vehicle reaches the intersection.

   6. The system shall have redundant communication from the in-vehicle devices to the traffic signal field devices using 900MHz radio, and 4G cellular communications and be capable of being upgraded to 5G when it becomes available.

   7. The system shall display the real time cabinet fault status of the traffic signal locations, should a user defined fault occur.

   8. The system shall issue autonomous real time alerts regarding user defined faults via SMS and email to personnel based on a user defined schedule.

   9. The system shall operate with cloud hosted software with user web based access, and with no software or IT infrastructure for the City-Parish to install or maintain. The system shall be capable of being transitioned to a locally hosted system server as a future option should

the City-Parish with to pursue it. The client user interface shall be browser based, with no software to be installed on client computers except for a standard browser.

10. The monitoring of the preempt system shall assure that the in-vehicle and the traffic signal field devices are functioning correctly and that the system will be available when required.

11. The field devices must be capable of receiving secure wireless software and security updates. The wireless updates shall allow new features to be installed remotely without having to physically go to the field devices to perform the update.

b. **Materials:** It is a requirement that the TSPRMS operate independent of the brand/type of intersection controller deployed at the intersection. The TSPRMS contractor shall install a small field device into each intersection cabinet which connects to the terminal strip in the cabinet (via a wiring harness) and enables the system to function independently of controller operation. The TSPRMS Field Device shall conform to the following requirements:

1. The field device shall function correctly between -30° F and +165° F.

2. The field device shall be a 1U rack mount device and suitable for placement in a traffic cabinet with all connections on the rear of the device and all LED indicators, power and selector switches on the front.

3. The field device shall be provided with appropriately rated connections that allow the device to be exchanged by unplugging connectors without the use of tools.

4. The field device shall incorporate an integrated GPS, cellular modem, and Ethernet fiber port.

5. The configuration of the field device shall be accomplished by accessing the internal web server with a browser. It shall be possible to configure the device without any special software.

6. The field device shall be powered via a standard 120Vac input power.

7. The field device shall allow for the routing of the controller configuration packets to and from the controller (either by Ethernet or serial communications) for each type of controller utilized by the Agency (Trafficware ATC and TS2). In this way, it shall be possible to configure the controller, and utilize the controller specific software to interrogate the controller. The TSPRMS shall provide the communication pipe which allows this to be accomplished.

8. The field device shall utilize field initiated communications. This allows for a low cost cellular data plans to be used with infrequent polling. However, when an abnormal event occurs and is detected by the field device, then the device will immediately initiate the transfer of a data packet to the TSPRMS to enable real-time alerting of response personnel to take place.

9. For field devices that are to be installed at field locations with existing high resolution fiber communication to the Advanced Traffic Management Center, there shall be the option to reduce cellular data transmissions in order to reduce the cost of those specific field devices.

10. The field device shall, within the 1U size limitation required above, include a battery and battery charging/monitoring circuit to allow the TSPRMS to function correctly even when

all power to the intersection has failed. The battery shall continue to power the field device for a minimum of five hours (5) after all power has failed to the intersection.

11. The field device shall incorporate an integrated GPS which will allow the device to geolocate itself on the map without configuration.

12. The field device shall operate without requiring a static IP address. The only configuration required at the device is to enter the URL of where the TSPRMS central software is hosted.

13. In the event that the communication to the TSPRMS central software is interrupted or is not available, the field device shall store any events that occur in internal memory and forward these events automatically to the TSPRMS when communication is restored. In this way, a complete record of events at the device can be maintained even if communication is interrupted for a period. The system will store a minimum of 5,000 events.

14. The field device shall utilize HTTP and HTTPS protocols and XML data structures for communications with the TSPRMS. In this way, the data will be open for future expansion and competition. The use of secret proprietary protocols is not permitted.

15. The field device shall include Ethernet communications with an RJ45 connector.

16. The field device shall not use self-tapping screws.

17. The field device shall have powered coated aluminum enclosures.

18. The field device shall include weather proof external antennas.

c. **Regulations and Code**: Contractors shall have a IMSA Traffic Signal Level 1 certified technician at all times at each work location and a IMSA Traffic Signal Level 2 certified technician to work in the cabinet for all signal work

d. **General Requirements**: The TSPRMS contractor shall configure the system and reports, and train the Agency in the correct operation of the system to enable the Agency to utilize the TSPRMS for the objectives outlined above.

Traffic Engineering Division shall be given a seven (7) days advance notice of testing and activation of the intersection preemption device and shall have a representative on site. Testing of equipment shall ensure that the preemptions are operating properly and safely. Specific items to be checked include (but are not limited to) the following:

1. Each approach to the intersection shall be set up such that the proper Emergency Vehicle Preempt (EVP) is activated and calls the proper phasing combination

2. EVPs shall NOT be set to nor default to "Flash in dwell"

3. When applicable, the RAIL preempt shall be tested to ensure that the RAIL preempt has priority over any and all EVPs (EVPs shall not override RAIL preempts and RAIL preempts shall override any and all active EMPs)

e. **Drawings and Equipment Submittals**: Prior to ordering/fabrication, electronically submit to the Engineer and Resident Project Representative, for approval, a PDF formatted letter on company letterhead for equipment submittals for all components to be furnished.

Show the project number, project location, project limits, pay item description, pay item number, manufacturer's name, and model number on each sheet. Each drawing shall also show the material specifications for each component proposed for use. All welds shall be identified by types and sizes.

1021-10 FLASHER ASSEMBLY:

a. **General:** The flashing switch specified herein shall be designated to operate on 110-130 volt, 60 cycle, alternating current, and shall be delivered completely wired and enclosed in a weatherproof cabinet. The flasher shall meet NEMA standards for a two (2) circuit flasher rated at fifteen (15) amps per circuit (Type 3).

These specifications define solid-state flashers that are used to periodically interrupt a source of alternating-current line power for the purpose of providing flashing traffic signals and flashing beacons. For the purpose of these specifications, the term “solid state” shall be defined as the main current to the signal load is not switched by electro-mechanically operated contacts. The flasher shall be certified by an independent laboratory as conforming to NEMA TS-1, Section 8, and Section 2.2.3.2. This certificate shall be included with the drawing and literature for this equipment.

b. **Flasher Cabinet:** Unless otherwise specified, the vendor shall furnish the controller completely housed in a weatherproof aluminum housing of clean-cut design and appearance. A hinged door shall be provided permitting complete access to the interior of the box. When closed, the door shall butt against a resilient neoprene sponge gasket to create a waterproof seal between the door and the housing. The door shall be provided with a standard lock with one key (Corbin # 1) and shall have an outside designation “Traffic Control” or “Traffic Signals” cast or embossed into the metal with letters 3/4" high or larger. The cabinet interior shall have minimum dimensions measuring 9-3/4” wide, 12” long and 5-1/2” deep.

All cabinets, unless otherwise specified, shall be suitable for wood pole mounting. The manufacturer shall drill the cabinet for two (2x) 2” wire entrance holes, one (1) in the top and one (1) in the bottom, as shown in Detail 1 ‘Cabinet Wire Entrance’. The wire entrance holes shall be located on the back edge of the cabinet and centered on the width of the cabinet. When the installer attaches the hubs to the cabinet, the hub shall align on the center of the entrance hole. The vendor shall supply lock washers and hex nuts for the bolts to attach to the hub. The bolt pattern for the hub is 2-1/8” centered on a line perpendicular to the outside back of the cabinet and 3-3/4” parallel to the back of the cabinet. Mounting holes for the bolts shall be 3/8”. The centers of the bolt pattern on the hub and the wire entrance hole shall coincide. The location of the hubs shall allow minimum clearance for box end wrenches to fit onto the nuts within the cabinet. The cabinet exterior shall be finished with two coats of high-grade green enamel (Outdoor Advertising Association of America No. 144). A color chip shall be available on request. Each coat shall be independently baked to resist peeling and chipping. The interior shall be furnished with gloss white enamel by the manufacturer.

c. **Hub, Conduit:** Hubs for the cabinet shall be cast aluminum, ASTM B-108. The bolt pattern shall be as shown in Detail 1 ‘Cabinet Wire Entrance’. The blank hub shall be a flat plate, ¼” thick. All threaded hubs shall have a threaded collar a minimum of 2” from the base of the hub.

The manufacturer shall center the threaded opening within the 3 ¾" dimension of the hub and the outside edge of the threaded collar in line with the back of the hub. The manufacturer shall make all hubs with stainless steel bolts casted into the hub. The manufacturer shall design the hub with the outside smooth to shed water. On hubs with a larger threaded collar, the design shall maintain the bolting pattern.

TYPE	OPENING (S) SIZE	OPENING DESCRIPTION
blank	- 0 -	no opening, flat plate, ¼" minimum thickness
single	¾"	one (1) opening, ¾" conduit thread
single	1"	one (1) opening, 1" conduit thread
single	1 ½"	one (1) opening, 1 ½" conduit thread
Single	2"	one (1) opening, 2" conduit thread
Single	2 ½"	one (1) opening, 2 ½" conduit thread
Single	3"	one (1) opening, 3" conduit thread
Double	¾"	two (2) openings, each ¾" conduit thread
Double	1"	two (2) openings, each 1" conduit thread

d. **Cabinet Hub Description:** Unless otherwise noted on the order, the vendor shall provide two (2) hubs for each cabinet. One (1) hub shall be a double ¾" and the other shall be blank.

e. **Mounting Adapter:** The vendor shall provide two (2) pole adapters as shown in Detail 2 'Pole Mounting Adapter'. The adapter shall be conformable for mounting to round poles with diameters of 4 ½" or larger. Material for the adapter shall be aluminum alloy 6061 or 5052-H32. The minimum thickness shall be 1/8". The material shall have the mechanical strength to hold, in addition to the cabinet, the added weight and load of items such as conduit, cables, service equipment, etc. The mounting holes in the adapter shall be 5/8" and slots for steel banding shall be 1-1/8" by ¼". The adapter shall be installed with the hubs and use the same mounting bolts of the hub. The vendor shall supply gaskets for installation between the cabinet, hub, and adapter.

f. **Gasket:** The manufacturer shall cut the gasket to fit the bolt pattern specified for the hub and wire-way opening. The material for the gasket shall be 50% cork and 50% neoprene material. The vendor shall send four (4) gaskets with each cabinet.

g. **Flasher Characteristics:** Flashers shall have the following Physical Characteristics:

1. The overall dimensions of the flasher shall not exceed 8.25 inches from the mating connector, including any handle or gripping device. The flasher shall be no more than 4.2 inches high.

2. Intermate with a Cinch-Jones socket type S-406-SB or equivalent.

3. Be so constructed that its lower surface will be no more than 2.1 inches below the centerline of connector configuration.

4. Be so constructed that no part of it will extend more than 0.9 inches to the left and 1.1 inches to the right of the centerline of connector pin configuration as viewed from the front.

5. Be so constructed that personnel inserting or removing the module will not be exposed to live parts nor be required to insert either their hands or fingers into a load rack.

6. All printed circuit boards shall be made from NEMA (FR-4) glass-epoxy, or equivalent (See NEMA Standards Publication No. LI 1-1971). Circuit boards exceeding 2 inches in any dimension shall have a nominal thickness of at least 1/32" inches.

All PC boards shall be coated with an epoxy or approved equal type material to prevent erratic performance due to high humidity, condensation, and growth of fungus and mildew. This coating will not cover the components on the board, but once the components are in place, the soldered joints shall be covered with moisture and fungus proof, clear type of acrylic lacquer.

This coating shall not be injurious to the board or components and shall not interfere with the repair of the circuitry or replacement of components.

The walls of all plated through holes shall have a minimum copper plating thickness of 0.001 inches. All circuit tracks shall have conductivity equivalent to at least 2 ounces per square foot of copper (2 oz/ft² Cu).

All electrical mating surfaces shall be made of non-corrosive material. The unit shall be designed so that each component is identified by a circuit reference symbol. This identification may be affixed to the printed circuit boards, the cover of the unit, or in an assembly drawing provided with the unit.

h. **Back Panel Characteristics:** The manufacturer shall mount a back panel in the cabinet and shall have mounted on it cartridge type fuse, connector for NEMA Type 3 flasher, flasher support bracket, and permanently identified field terminals. The back panel size shall be nine inch (9") wide and twelve inch (12") high. The manufacturer shall have the back panel constructed of ¼" electrical grade masonite. The panel shall have four (4) mounting holes approximately 11/32" in diameter. The holes shall be centered on an eight inch by nine inch (8" x 9") bolt pattern. The bolt pattern shall be centered on the back panel. The back panel shall support the NEMA flasher from the panel along its longest dimension. The support shall not restrict removal or installation of the flasher unit on the back panel while the panel is in the cabinet. All wiring shall be on the front of the panel. The field terminals shall have wired to it only the circuits from the field.

i. **Electrical Characteristics:** Flashers shall have the following electrical characteristics:

1. The rating of the output circuit shall be the minimum rating for a tungsten lamp or gas-tuning-transformer load over a voltage range of 60 to 135 VAC at 60 hertz. The output circuit shall not be de-rated for the operation over the ambient range of -30 degrees to +165 degrees F and the humidity range as both detailed in TS 1-2.1.05.

2. Input to the solid-state flashers shall consist solely of the 60-hertz alternating-current power source. This input shall supply the power for the output circuit and also provide power to the flasher logic. The flasher shall turn on within 5 degrees of the zero voltage point of the alternating current line sinusoid and shall turn off within 5 degrees of the zero current point of the alternating-current line sinusoid. The flasher need not turn on within 5 degrees of the zero point of the alternating-current sinusoid for the first flash cycle (on-off cycle) after the initial application of alternating-current power to the flasher.

3. The "flashing" voltage output shall provide not less than 50, nor more than 60, flashes per minute with an on period of 50 + 5%.

4. The flasher output shall have a dv/dt rating of 100 volts per microsecond at 70 degrees F.

5. The flasher output shall have a peak standoff voltage of 480 VAC or greater at 70 degrees F.

6. The output current from the flasher through the load, when the flasher is in the off state, shall not exceed a maximum of fifteen (15mA) milliamperes rms.

7. The flashing output shall consist of two (2) outputs each rated at fifteen (15A) amperes.

8. Flashers shall be so designed that circuit #1 will be essentially ON when circuit #2 is OFF, and vice-versa. The principal purpose served by this arrangement is to smooth out the loading on the power source. The maximum OFF period when both circuit #1 and circuit #2 are OFF, or the maximum ON period when both circuit #1 and circuit #2 are ON, shall not exceed 17 milliseconds during the transition from OFF to ON to OFF.

9. The line power shall be fused with NON 0-30 amp fuse. This fuse shall be sized properly for the load limit of the flasher. The wiring shall be properly sized for the design current of each circuit. Separate terminals for the line and field neutral shall be provided.

10. Lightning protection shall be provided for line input and each signal circuit. A gas filled fuse shall be across the line input on the load side of the fuse. It shall be capable of clamping input voltage at 350 volts. A MOV shall be on each signal circuit and provide a minimum clamping voltage of 395 volts and dissipate thirty (30) joules of energy (GE - V150LA10A or approved equal).

11. All electrical connectors shall be insulated from the back panel at a 600 VAC rating.

j. **Literature:** One (1) set of complete literature shall be furnished with the unit. The literature must include, at least, the following information: parts list, operating instructions, wiring diagrams complete with (when appropriate) waveform data, peak voltage data, and schematic diagrams.

1021-11 CONDUIT RISER ASSEMBLY: This item consists of furnishing all labor, equipment and materials necessary for the complete installation of a riser and related work in accordance with plan details. The Contractor shall submit shop drawings of the electrical pole riser with weatherhead to the Traffic Engineering Division for approval prior to installation. The diameter of the riser shall be of adequate capacity per latest NEC to house the required wiring as shown on the plans. The electrical grade aluminum riser shall be in accordance with City Standards.

1021-12 EMERGENCY EVACUATION SURVEILLANCE EQUIPMENT:

1021-12.1 CCTV Camera Assembly (Furnish and Install with PTZ, Digital):

a. **Materials:** All equipment shall be new and constructed using current industry standards and techniques to assure high reliability and minimum maintenance. The contractor shall submit for review, prior to installation, a complete set of shop drawings of all the equipment and components listed below and included as part of the installation.

The components of the CCTV camera assembly described by this specification shall consist of the following:

1. Camera imaging unit
2. Pan tilt unit
3. Camera housing
4. Mounting and wiring

b. **Technical Requirements:**

1. The Surveillance Camera System (SCS) shall be of type Pan, Tilt & Zoom (PTZ) with an optical zoom lens.
2. The SCS system shall support Ethernet communications for transfer of video and updating configurations and firmware. This shall be accomplished using standard TCP/IP network protocols.
3. The SCS shall support the following networking protocols: IPv4/IPv6, HTTP, HTTPS, 802.1x, Qos, FTP, SMTP, UPnP, SNMP, DNS, DDNS, NTP, RTSP, RTCP, RTP, TCP/IP, IGMP(v2/v3), DHCP, PPPoE, Security User authentication, IP filtering, Digest authentication (RTSP, HTTP), HTTPS encryption (TLS1.2); IEEE 802.1x port-based network access control
4. The SCS shall support the following IP control protocols: Onvif (Profiles S, G, & Q)
5. The SCS shall have local SDHC/SDXC storage availability.
6. The SCS Lens shall be made of High-grade optical glass.
7. The SCS shall have a minimum 30x optical zoom and a minimum 10x digital zoom.
8. The SCS shall have a Pan range of 360° continuous and a Tilt range of at least -20° to +90°.
9. The SCS shall have a Dynamic Range of atleast 120 db and a SNR better than 54 db.
10. The SCS shall use the following video compression standards: H.265, H.264 Main, H.264 Profile, and MJPEG.
11. The SCS shall support multiple resolutions including at a minimum the following: 2065x1553 (3MP), 1920x1080, 1280x1024, 1280x720, 1024x768, 800x600, 720x567, 640x480, and 352x288.
12. The SCS must support Constant bit rate (CBR), variable bit rate (VBR), and Low bit rate (LBR).
13. Shall operate at temperatures -40° F to +122° F and shall be capable of operating within weather conditions in Louisiana. Must be constructed so as to be waterproof to the IP67 standard.
14. The SCS shall operate normally at an input voltage of 12 VDC or 24 VAC.
15. The SCS shall include a POE (Power over Ethernet) power supply.
16. The SCS shall be mounted using an Astro-Brac clamp kit (or approved equal) with a

Schedule 40 120" bent aluminum mounting tube, Camera mounting adapter, and articulating camera mount.

c. **Installation:**

1. Contractor shall install the C-P supplied SCS following all State and City-Parish construction standards and permitting regulations.

2. Contractor shall notify the C-P TED Project Engineer a minimum of five (5) days prior to beginning work.

3. Contractor shall furnish and install all hardware, conduits and wiring materials needed for the complete installation and connection of the SCS system at the intersection.

4. Wiring for the SCS within the traffic signal controller cabinet must be sized in accordance with the National Electric Code (NEC) and must conform to the requirements of the Agency Specifications. Wiring panels and terminal blocks must be neatly, clearly and permanently marked. Conductors must be neatly arranged and bundled in groups with cable ties. The bundled conductors shall not obstruct access to other circuits and terminals in the cabinet.

5. The camera shall be mounted with an Astro-Brac (or approved equal) using the clamp sized appropriately to the mast-arm or pole that the camera is mounted to. The Bent Pipe shall be mounted to arm or pole with the Astro-Brac and the camera shall be mounted to the top of the pipe with the adapter and mount.

6. Determination of the location on either the mast arm or signal pole at the location will be determined by a site survey done by the Project Engineer and the contractor before installation begins.

d. **Testing:** The Contractor will provide a test plan to the City Parish Traffic Engineer, based on the approved submitted product, during construction that the contractor shall follow.

The City Parish Traffic Engineer and other designated principals will witness the testing to provide quality assurance. The results of each test step in the script shall be assessed using pass/fail designators. At the successful completion of each commissioning test for a particular site, the site will be deemed commissioned.

The contractor shall provide the Project Engineer and have on site, during the commissioning testing, all applicable documentation concerning the devices being tested and used.

DRAWINGS:

1. Delete Sheet 5 and replace with Revised Sheet 5.
2. Add Sheet 15a

APPROVED:

Thomas Stephens, P.E.
Chief Design & Construction Engineer