



# Illinois Department of Transportation

2300 South Dirksen Parkway / Springfield, Illinois / 62764

June 6, 2018

SUBJECT FAP Route 317 (US 24/IL 9)  
Project HSIP-DI5X (017)  
Section 45TS-1  
Peoria County  
Contract No. 68E03  
Item No. 128, June 15, 2018 Letting  
Addendum A

## NOTICE TO PROSPECTIVE BIDDERS:

Attached is an addendum to the plans or proposal. This addendum involves revised and/or added material.

1. Revised the Schedule of Prices.
2. Revised the Table of Contents to the Special Provisions.
3. Revised page 51 of the Special Provisions.
4. Added pages 52-100 to the Special Provisions.
5. Revised sheets 4, 6, 8-15, 19, 20 and 22 of the Plans.

Prime contractors must utilize the enclosed material when preparing their bid and must include any changes to the Schedule of Prices in their bid.

Very truly yours,

Jack A. Elston, P.E.  
Bureau Chief  
Bureau of Design and Environment

A handwritten signature in cursive script, reading "Ted B. Walschleger P.E.".

By: Ted B. Walschleger, P. E.  
Engineer of Project Management

cc: Kensil Garnett, Region 3, District 4; Tim Kell;

JW/ab

RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES (BDE)..... 34  
 SPEED DISPLAY TRAILER (BDE)..... 44  
 STEEL COST ADJUSTMENT (BDE)..... 45  
 SUBCONTRACTOR AND DBE PAYMENT REPORTING (BDE)..... 48  
 SUBCONTRACTOR MOBILIZATION PAYMENTS (BDE) ..... 48  
 WARM MIX ASPHALT (BDE) ..... 49  
 WEEKLY DBE TRUCKING REPORTS (BDE)..... 50  
 WORKING DAYS (BDE)..... 51  
 TRAFFIC SIGNAL DETECTION CONTROL SYSTEM..... 51  
 CONTRACT GUARANTEE..... 53  
 SIGN PANEL – TYPE 1 ..... 53  
 SERVICE INSTALLATION, TYPE B..... 54  
 ELECTRIC CABLE IN CONDUIT, EQUIPMENT GROUNDING CONDUCTOR, NO. 6 1C ..... 55  
 HANDHOLE, PORTLAND CEMENT CONCRETE ..... 56  
 DOUBLE HANDHOLE, PORTLAND CEMENT CONCRETE ..... 57  
 FULL ACTUATED CONTROLLER AND TYPE V CABINET, SPECIAL ..... 57  
 SPARE FULL ACTUATED CONTROLLER, SPECIAL ..... 60  
 CELLULAR MODEM..... 60  
 INDUCTIVE LOOP DETECTOR..... 66  
 TRAFFIC SIGNAL LED MODULE SPECIFICATIONS ..... 67  
 SIGNAL HEAD, LED..... 71  
 TRAFFIC SIGNAL BACKPLATE, RETROREFLECTIVE..... 72  
 TRAFFIC SIGNAL POST, GALVANIZED STEEL, 15 FT. .... 72  
 TRAFFIC SIGNAL BATTERY BACKUP SYSTEM ..... 73  
 CLOSED-CIRCUIT TELEVISION DOME CAMERA, IP BASED..... 82  
 CAT 5 ETHERNET CABLE..... 88  
 LUMINAIRE, LED, HORIZONTAL MOUNT, OF THE WATTAGE SPECIFIED ..... 89  
 ELECTRIC CABLE IN CONDUIT, EQUIPMENT GROUNDING CONDUCTOR, NO. 6 1C ..... 97  
 DETECTOR LOOP, SPECIAL ..... 97  
 ELECTRIC CABLE IN CONDUIT, LEAD-IN, NO. 12 1 PAIR ..... 99  
 SHOULDER REMOVAL AND REPLACEMENT FOR ELECTRICAL WORK..... 100

**WORKING DAYS (BDE)**

Effective: January 1, 2002

The Contractor shall complete the work within 45 working days.

**TRAFFIC SIGNAL DETECTION CONTROL SYSTEM**

PROPOSED TRAFFIC SIGNAL CONTROL EQUIPMENT AND TRAFFIC SIGNAL DETECTION CONTROL SYSTEM

The Contractor shall provide the following system:

Naztec D-CS (Consists of Naztec traffic signal control equipment and detector loops installed in the pavement)

The traffic signal controller, cabinet, components, and vehicle detectors shall form a complete system. All components supplied under this pay item shall be new and have a two-year manufacturer's warranty (parts and labor).

The system (including the controller cabinet and components) shall be subject to a 60-day burn-in period. The Contractor shall notify the Department a minimum of three days in advance to schedule turn-on. The Contractor and equipment manufacturer's representative shall demonstrate the system to the Engineer to show that it meets all the required design and installation parameters. After, the system has been accepted by the Engineer, the system shall begin a sixty-day "burn-in" period. During the "burn-in" period, the components shall perform continuously, without any interruption of operation, for a period of sixty days. In the event that there are operational problems during the burn-in period, the burn-in period shall reset back to day one.

After the successful completion of the burn-in period, the system will have completed final acceptance.

Revised 6/6/18

## NAZTEC DETECTION CONTROL SYSTEM

### DETECTION CONTROL SYSTEM (D-CS) OPERATIONAL PARAMETERS

The detection control system (D-CS) was developed by the Texas Transportation Institute to minimize delay and crash frequency at rural intersections. An algorithm was created to calculate and vary the dilemma zone protection based upon vehicle location, speed, and classification. This algorithm was implemented by Naztec Inc. to run on a Type 2070 controller platform as part of an engineered system that includes a traffic signal controller, cabinet, and other system components.

The D-CS uses vehicle speed and length information to predict the “best” time to end a phase that is being serviced. The traffic signal controller is equipped with a D-CS software module that utilizes information obtained from the detector loops to predict the arrival of a vehicle in the dilemma zone. The system has been designed to identify the best time to end the major-road through phase based on consideration of the number of vehicles in the dilemma zone, the number of trucks in the dilemma zone, and the waiting time of vehicles in conflicting phases.

The system uses two detectors per lane (in a speed trap configuration) that are located between 700 to 1000 feet in advance of the intersection. The D-CS uses detector information to calculate vehicle length, speed, and lane location and uses this information to make decisions about whether to hold a current phase in green or to terminate it. The system will search for a time when each vehicle that is being served is outside of its respective dilemma zone. In the event that this time cannot be found, the D-CS system will seek a time when the fewest vehicles will be in the dilemma zone, relative to the duration of the look-ahead time window.

The final report and supporting documents from the Texas Transportation Institute can be found at <http://tcd.tamu.edu/Documents/4022-2.pdf>

Added 6/6/18

## **CONTRACT GUARANTEE**

The Contractor shall guarantee all electrical equipment, apparatus, materials, and workmanship provided under the contract for a period of six (6) months after the date of final inspection according to Article 801.14.

All instruction sheets required to be furnished by the manufacturer for materials and supplies and for operations shall be delivered to the Engineer prior to the acceptance of the project, with the following warranties and guarantees:

1. The manufacturer's standard written warranty for each piece of electrical equipment or apparatus furnished under the contract.
2. The Contractor's written guarantee that, for a period of six (6) months after the date of final inspection of the project, all necessary repairs to or replacement of said warranted equipment, or apparatus shall be made by the Contractor at no cost to the Department.
3. The Contractor's written guarantee for satisfactory operation of all electrical systems furnished and constructed under the contract for a period of 6 months after final inspection of the project.

## **SIGN PANEL – TYPE 1**

This work shall be in accordance with Sections 720 and 1090, 1091, and 1092 of the Standard Specifications except as modified herein.

The Contractor shall furnish “Left Turn Yield on Flashing Arrow” signs as shown on the plan sheet detail and install them on the mast arms (to the right of the flashing yellow arrow signal head) at the locations indicated on the plan sheets.

The contractor shall supply all materials required to install the sign (stainless steel banding, brackets, hardware, etc.) as a part of this pay item.

Basis of Payment: This work shall be paid for at the contract unit price per square foot for SIGN PANEL – TYPE 1 which price shall be payment in full for all labor, equipment, and materials required to supply and install the sign panel described above, complete.

Added 6/6/18

## **SERVICE INSTALLATION, TYPE B**

This work shall be in accordance with Section 805 and 1086 of the Standard Specifications except as modified herein.

The service installation shall include furnishing and installing a 25' treated wood pole for an overhead service drop, disconnect switch, and all associated appurtenances including a meter base if required by the utility company. The service disconnects shall be mounted on the wood post.

Galvanized steel conduit shall be used for the service riser. The use of PVC conduit will not be allowed.

A rain tight hub assembly (Myers type) shall be used when conduit enters the switch from the top of the disconnect.

The service disconnect switch shall be a stainless steel, weatherproof NEMA 4X enclosure that meets the following specifications:

60-Ampere (250 V) Minimum Fused Disconnect Switch: Unless indicated otherwise on the plan sheets, the fused disconnect switch shall be single-throw, three-wire (two poles, two fuses, and solid neutral). The switch shall provide for locking the blades in either the "On" or "Off" position with one or two padlocks and for locking the cover in the closed position. The disconnect switch and fuse rating shall be rated at the voltage and amperage required to comply with utility company and equipment requirements. All fuses shall be provided with the disconnect installation.

The service disconnect shall be installed at a maximum height of 42".

The Department will furnish all padlocks.

Basis of Payment: This work shall be paid for at the contract unit price each for SERVICE INSTALLATION, TYPE B which price shall be payment in full for all labor, equipment, and materials required to provide and install the electrical service installation described above, complete.

Added 6/6/18

**ELECTRIC CABLE IN CONDUIT, EQUIPMENT GROUNDING CONDUCTOR, NO. 6 1C**

This work shall be in accordance with the applicable Articles of Sections 801, 806, 873, 1076, and 1088 of the Standard Specifications with the following modifications:

This work shall consist of furnishing and installing a grounding wire to bond all traffic signal handholes (lids and rings), mast arm assemblies, posts, light poles, cabinets and exposed metallic conduits.

The Contractor shall attach the proposed ground wire to the proposed traffic structures to ground and safety bond them in accordance with NEC requirements. All labor, materials, and equipment required to bond the proposed structures (wire, clamps, hardware, etc.) shall be included in the bid price for this pay item.

The Contractor shall also be responsible for locating all handholes and uncovering them as required to facilitate the work.

The proposed ground wire shall be an insulated #6 XLP copper conductor with green insulation.

Basis of Payment: This work will be paid for at the contract unit price per foot for ELECTRIC CABLE IN CONDUIT, EQUIPMENT GROUNDING CONDUCTOR, NO. 6 1C which price shall be payment in full for all labor, materials, and equipment required to provide the grounding cable described above.

Added 6/6/18

## **HANDHOLE, PORTLAND CEMENT CONCRETE**

This work shall consist of furnishing the materials and constructing a handhole in accordance with the applicable Articles of Section 814 and 1088 of the Standard Specifications with the following modifications:

The lift ring for the cover shall consist of a solid closed ring of stainless steel at least 3/8 inch in diameter. The lift ring shall be attached to the cover by a loop of stainless steel at least 3/8 inch in diameter. The lift ring and loop shall be recessed in the cover.

The Contractor shall install heavy-duty, fully-galvanized hooks, with a minimum diameter of 1/2" in the proposed handhole. The Contractor shall submit this material to the Engineer prior to construction of the handholes.

The lid shall be marked with the legend "Traffic Signals".

Pre-cast handholes are not allowed.

All unsuitable materials shall be disposed of by the Contractor outside the job limits.

Basis of Payment: This work will be paid for at the contract unit price each for HANDHOLE, PORTLAND CEMENT CONCRETE which price shall be payment in full for all labor, materials, and equipment required to provide the handhole described above as well as any necessary excavating, backfilling, disposal of unsuitable materials, and furnishing all materials within the limits of the handhole.

Added 6/6/18



### **DOUBLE HANDHOLE, PORTLAND CEMENT CONCRETE**

This work shall consist of furnishing the materials and constructing a double handhole in accordance with the applicable Articles of Section 814 and 1088 of the Standard Specifications with the following modifications:

The lift ring for the cover shall consist of a solid closed ring of stainless steel at least 3/8 inch in diameter. The lift ring shall be attached to the cover by a loop of stainless steel at least 3/8 inch in diameter. The lift ring and loop shall be recessed in the cover.

The Contractor shall install heavy-duty, fully-galvanized hooks, with a minimum diameter of 1/2" in the proposed handhole. The Contractor shall submit this material to the Engineer prior to construction of the handholes.

The lid shall be marked with the legend "Traffic Signals".

Pre-cast handholes are not allowed.

All unsuitable materials shall be disposed of by the Contractor outside the job limits.

Basis of Payment: This work will be paid for at the contract unit price each for DOUBLE HANDHOLE, PORTLAND CEMENT CONCRETE which price shall be payment in full for all labor, materials, and equipment required to provide the handhole described above as well as any necessary excavating, backfilling, disposal of unsuitable materials, and furnishing all materials within the limits of the handhole.

### **FULL ACTUATED CONTROLLER AND TYPE V CABINET, SPECIAL**

This work shall be in accordance with Sections 857, 1073, and 1074 of the Standard Specifications except as modified herein.

The cabinet and controller shall be compatible with a Naztec closed loop system and Streetwise remote monitoring software.

The controller shall be a Naztec 981 NEMA TS2 Type 2 controller equipped with Ethernet port, data key and DCS firmware.

The controller shall be equipped with the DCS (Detection Control Software) module.

Added 6/6/18

The traffic signal cabinet shall have a 16-position load switch NEMA TS-2 back panel. The cabinet shall include a malfunction management unit to allow enhanced fault monitoring capabilities.

The malfunction management unit shall support flashing yellow arrow operation and shall be a Reno A&E model MMU2-1600G equipped with a graphical display and Ethernet port.

The malfunction management unit shall be equipped with the latest software and firmware revisions.

The cabinet shall be equipped with a plexi-glass shield that covers the power panel which houses the mercury bus relay, line filter, circuit breakers, and other electrical components.

The cabinet shall be equipped with a plexi-glass shield that covers the thermostat and a LED lighting assembly that turns on when the door is opened. The LED lighting assembly shall be mounted in a location that will not interfere with cabinet maintenance.

The traffic signal cabinet shall be equipped with a sixteen load switch back panel to accommodate future expansion.

The cabinet shall be furnished with a compact heater strip (to be used for moisture reduction during cold weather. The heater shall be thermostatically controlled, operate at 120 volts, have a minimum wattage of 150 watts, a maximum wattage of 250 watts, have a shield to protect service personnel and equipment from damaging heat, be separately fused, and be mounted where it does not interfere with a person working in the cabinet.

The cabinet shall be equipped with LED light bulbs.

The traffic signal cabinets shall be equipped with two non GFCI duplex NEMA 5-15R receptacles to be used to provide power to auxiliary equipment.

The cabinet shall be equipped with a 30A two space, two circuit, indoor main lug load center rated at 120/240 VAC and 10,000 AIR short circuit current rating (Square D model number QO2L30SCP or equivalent) and button photocell installed inside the cabinet overhang for the proposed overhead lighting.

The cabinet shall also be equipped with all other components necessary to provide for a complete and functional remote monitoring through a cellular modem connection.

The cabinet shall be equipped with toggle switch guards for all switches located on the door to prevent accidental switching. The cabinet shall include a high quality deluxe pleated filter.

Added 6/6/18

The cabinet shall be equipped with additional surge protection for the controller, malfunction management unit, and detector amplifiers, and/or video detection system. The surge protector shall be a Transtector model ACP100BWN3 and shall be included in addition to an EDCO SHA-1250 IRS protector. The EDCO SHA-1250 IRS surge protector is to be provided in accordance with Section 1085.47 A(4a) and shall be wired to provide surge protection for the controller, malfunction management unit, and detector amplifiers. The Transtector surge suppressor may be wired to the equipment protected power terminals of the EDCO SHA-1250 IRS unit provided that the controller, MMU, and detection system are protected.

The Contractor shall set up each cabinet in his or her shop for inspection by the Engineer. All phases that are utilized shall be hooked up to a light board to provide observation for each signal indication. The Engineer shall be notified when the setup is complete so that all pertinent timings may be entered the traffic signal controller. The facility shall be subject to a seven-day burn-in period before installation will be allowed.

After installing the cabinet in the field, prior to resuming normal signal operation, the Contractor shall test the cabinet by connecting a jumper to the cabinet field terminals to ensure that all conflicting signals will place the cabinet into conflict flash and to verify that the cabinet, controller, and malfunction management unit are operating correctly. The Contractor shall make arrangements with the local police agency to provide traffic control during the conflict test.

Basis of Payment:

This work will be paid for at the contract unit price each for FULL ACTUATED CONTROLLER AND TYPE V CABINET SPECIAL and shall be payment in full for all labor, materials, and equipment required to remove the existing traffic signal cabinet and furnish, install, and test the traffic signal cabinet described above, complete.

Added 6/6/18

### **SPARE FULL ACTUATED CONTROLLER, SPECIAL**

This work shall be in accordance with the applicable Articles of Sections 895, 1073, and 1074 of the Standard Specifications with the following modifications:

This item shall consist of furnishing a spare controller and delivering it to the Peoria County Highway Department.

The Contractor shall furnish and deliver the following items:

- Naztec 981 NEMA TS2 Type 2 controller equipped with Ethernet port, data key and DCS firmware – Qty. 1

The Contractor shall deliver the controller and associated items to the IDOT Traffic Building located at 1025 W. Detweiller Drive, Peoria IL. The Contractor shall notify Tony Bridson, at (309) 671-4464 a minimum of forty-eight hours prior to delivery.

Basis of Payment: This work shall be paid for at the contract unit price per each for SPARE FULL ACTUATED CONTROLLER, SPECIAL which price shall be payment in full for all labor, equipment, and materials required to furnish the controller described above and deliver it to the IDOT traffic building.

### **CELLULAR MODEM**

The Contractor shall furnish an industrial cellular router with two years of cellular service, industrial power supply, and externally mounted cellular antenna and deliver it to the Department.

The cellular router shall include two years of pre-paid wireless cellular service (10 GB monthly data plan) from Verizon Wireless.

The service period shall not begin until the traffic signals have been installed and are fully operational. The Contractor shall transfer the service and account to the Department at the end of the two-year period.

The Contractor shall install the cellular router and industrial power supply inside the proposed traffic signal cabinet using DIN rail mounting. The Contractor shall furnish and install all wiring and hardware required to install the cellular router, power supply, and external antenna.

Added 6/6/18

The cellular router shall be a Red Lion IndustrialPro SN-6921-VZ 4G LTE or approved equal that meets or exceeds the following minimum specifications:

### FEATURES & BENEFITS

- |                                |  |
|--------------------------------|--|
| Cellular Connectivity:         | <ul style="list-style-type: none"><li>• Verizon LTE with fallback to EVDO</li><li>• 3G (GSM WCDMA/HSDPA/HSUPA or EVDO Rev A)</li></ul>   |
| Built-In Security & Routing:   | <ul style="list-style-type: none"><li>• Secure modbus data using IPsec VPN tunnels</li><li>• VPN tunnel: IP SEC, SSL</li><li>• Port forwarding</li><li>• Stateful Firewall</li><li>• Packet Filtering</li><li>• Access Control List (ACL)</li></ul>                                  |
| Powerful Web-Based Management: | <ul style="list-style-type: none"><li>• Provides remote monitoring and control</li><li>• Mass activation and device upgrades</li><li>• Remote diagnostics and troubleshooting</li><li>• Reporting of key metrics</li></ul>   |
| Rugged, Compact Design:        | <ul style="list-style-type: none"><li>• -40 to +85°C operating temperature</li><li>• DIN-rail mounting</li></ul>   |
| Features:                      | <ul style="list-style-type: none"><li>• Connect multiple devices to single WAN link</li><li>• Remote TCP/IP based capabilities</li><li>• Integrated switching/routing capabilities</li><li>• Serial to IP conversion</li><li>• Access IP and serial devices simultaneously</li></ul> |

### SPECIFICATIONS

- |                     |  |
|---------------------|--|
| Wireless Interface: | <ul style="list-style-type: none"><li>• Dual-band CDMA2000 EVDO Rev. A (backward compatible with 1xRTT)</li><li>• GSM HSPA (backward compatible with EDGE)</li><li>• EDGE/GPRS</li></ul> |
| Ethernet Interface: | <ul style="list-style-type: none"><li>• 5x RJ45 Ethernet 10/100 auto-sensing</li></ul>   |
| Serial Interface:   | <ul style="list-style-type: none"><li>• 1x RS-232 Serial DB9 115200bps</li></ul>   |
| USB Interface:      | <ul style="list-style-type: none"><li>• 1x USB2.0 mini</li></ul>   |

Added 6/6/18

- LED Status Indicators:
  - Power, WAN, Signal, RS232, Ethernet Link and Activity
- Dimensions:
  - Steel 120 x 96 x 51 mm (4.7" x 3.77" x 2.0"), 500g (1.1 lbs)
- Power Input:
  - 8 - 30 Vdc (12Vdc nominal)
- Environmental:
  - Operating Temp: -40 to +85°C
  - Shock: IEC60068-2-27,
  - Vibration: IEC60068-2-6
  - Humidity: 5 to 95% non-condensing
- Certification:
  - EMC:FCC, part 15 and Industry Canada, ICES-003
  - Hazardous Locations: Class I, Div. 2, Groups A,B,C,D, UL1604
  - Electrical Safety: UL508/CSA22.2/14 (CUL)
- Routing Protocols:
  - OSPF, BGP, RIP
- Encapsulation Protocols:
  - GRE and IPinIP
- Tunneling:
  - VPN: IPSec and SSL
- Clustering:
  - VRRP
- IP:
  - NAT, Port Forwarding, Dynamic DNS, DHCP
  - Stateful Inspection Firewall, IP Transparency
- Warranty:
  - 3 years on design and manufacturing defects

Added 6/6/18

The Contractor shall furnish an Aaxeon Model DR-4512 45 watt industrial DIN rail power supply or approved equal that meets or exceeds the following specifications:

OUTPUT

- DC Voltage: • 12V
- Rated Current: • 3.5A
- Current Range: • 0-3.5A
- Rated Power: • 42W
- Ripple & Noise (Max.): • 200mVp-p
- Voltage Adjustment Range: • 10.8 – 13.2V
- Voltage Tolerance: • +/- 1.0%
- Line Regulation: • +/- 1.0%
- Load Regulation: • +/- 1.0%
- Setup, Rise Time: • 800ms, 60ms/230VAC at full load
- Hold Time (Typ.) • 100ms/230VAC at full load

INPUT

- Voltage Range: • 85 – 265 VAC, 120 – 370 VDC
- Frequency Range: • 47 – 63 Hz
- Efficiency (Typ.): • 77%
- AC Current (Typ.): • 1.5A/115VAC, 0.75A/230VAC
- Inrush Current (Typ.): • Cold Start 28A/115VAC, 56A/230VAC
- Leakage Current: • <1mA/240VAC

Added 6/6/18

PROTECTION

- Over Load:
  - 105 – 150% rated output power (Protection Type: Constant current limiting, recovers automatically after fault condition is removed)
  
- Over Voltage:
  - 13.8 – 16.2V (Protection Type: Shut down o/p voltage, re-power on to recover)
  
- Over Temperature:
  - 135 degrees C (Protection Type: Shut down o/p voltage, recovers automatically after temperature goes down)

ENVIRONMENT

- Working Temperature:
  - -10 to 50 degrees C
  
- Working Humidity:
  - 20 – 90% Non-condensing
  
- Storage Temperature
  - -20 to 85 degrees C
  
- Storage Humidity:
  - 10 to 95% Relative Humidity

SAFETY

- Safety Standards:
  - UL 508
  
- Withstand Voltage:
  - I/P-O/P:3KVAC, I/P-FG:1.5KVAC, O/P-FG:0.5KVAC
  
- Isolation Resistance:
  - I/P-O/P, I/P-FG, O/P-FG:100M Ohms/500VDC
  
- Harmonic Current:
  - Compliance to EN61000-3-2,-3
  
- EMI Conduction and Radiation:
  - Compliance to EN55011, EN55022

OTHER

- Mounting
  - DIN Rail

Added 6/6/18



The Contractor shall furnish and install a NEMA 15-R power cable (3 ft. length) and install the power supply in the proposed equipment cabinet and connect the cellular modem to it.

The cellular modem shall be equipped with an external antenna that shall be attached to the nearest mast arm strain pole and aimed at the nearest Verizon cellular tower.

The cellular antenna shall be a Wilson Electronics 14 dBi Gain 1900 MHz Yagi Antenna (Product Number 311124) or approved equal that meets or exceeds the following specifications:

- |                     |  |
|---------------------|--|
| Features:           | <ul style="list-style-type: none"><li>• Supports 1900MHz PCS Frequency band, Compatible with all PCS providers, Built-in ground plane</li></ul>              |
| Antenna Type:       | <ul style="list-style-type: none"><li>• Directional</li></ul>  |
| Number of Elements: | <ul style="list-style-type: none"><li>• 9</li></ul>  |
| Material:           | <ul style="list-style-type: none"><li>• Aluminum</li></ul>   |
| Frequency Range:    | <ul style="list-style-type: none"><li>• 1850-1990 MHz</li></ul>  |
| Impedance:          | <ul style="list-style-type: none"><li>• 50 Ohms</li></ul>  |
| Antenna Gain:       | <ul style="list-style-type: none"><li>• 14 dBi (1710-1880 MHz and 1850-1990 MHz)</li></ul>   |
| Beam Width:         | <ul style="list-style-type: none"><li>• H 31 Degrees, V 31 Degrees</li></ul>   |
| Polarization:       | <ul style="list-style-type: none"><li>• Vertical</li></ul>   |
| Maximum Power:      | <ul style="list-style-type: none"><li>• 25 Watts</li></ul>   |
| Radiation:          | <ul style="list-style-type: none"><li>• Directional</li></ul>  |
| Connector:          | <ul style="list-style-type: none"><li>• N Female</li></ul>   |
| Dimensions:         | <ul style="list-style-type: none"><li>• Pole with U-Bolts</li></ul>  |
| Mounting:           | <ul style="list-style-type: none"><li>• U-Bolts, Mounts on pipe with 0.5 inch to 1.5 inch diameter</li></ul>   |
| Accessories:        | <ul style="list-style-type: none"><li>• RG-58 coax extension equipped with factory installed connectors for Yagi and cellular modem, 20 Ft. Length</li></ul> |

Added 6/6/18

The Contractor shall furnish and install all cables, brackets, pole mast and hardware required to install the antenna onto the traffic signal mast arm. The Contractor shall not drill any holes into the top of the proposed or existing traffic signal cabinets to mount the antenna.

Basis of Payment: This work will be paid for at the contract unit price per each for CELLULAR MODEM which price shall be payment in full for all labor, materials, and equipment required to provide the cellular modem complete with two years prepaid cellular data service and all accessories described above, configure the modem for operation with the proposed traffic signals and install it in the proposed and existing traffic signal controller cabinets.

## **INDUCTIVE LOOP DETECTOR**

This work shall be in accordance with Sections 885 and 1079 of the Standard Specifications except as modified herein.

The detector amplifier shall be equipped with an LCD display that is capable of displaying the loop frequency and inductance and shall conform to the following specifications:

- Custom LCD displays complete status and function settings of the detector.
- All functions are programmable from the front panel LCD "Menu" - no removing of detector to change function settings.
- LCD displays loop frequency, loop inductance, & -L/L% values.
- LCD displays the accumulated number of loop failure incidents since the detector was last reset - helps diagnose intermittent systems.
- LCD bar graph displays loop inductance change to verify ideal sensitivity level setting.
- Selectable "Continuous-CALL" and "Channel-Off" to aid system troubleshooting.
- 8 loop frequencies and 9 levels of sensitivity.
- 2 Selectable modes of operation: Presence or Pulse.
- 255 second CALL Delay and 25.5 second Extension timers.
- 999 second Max. Presence Timer. NEMA TS 2 Status Output.
- EOG (end of green) reset synchronization for Max. Presence timer.
- Super bright LEDS indicate vehicle detection or loop failure.
- Environmentally sealed push button switches to insure trouble-free service.
- Phase Green (Delay Override) input.

The detector amplifier shall be equipped with relay or solid state outputs to ensure that the detectors fail in a constant call mode.

The RENO A&E Model C-1200 Series and EDI Oracle Series are currently approved for use within the District.

Basis of Payment: This work shall be paid for at the contract unit price each for INDUCTIVE LOOP DETECTOR which price shall be payment in full for all labor, equipment, and materials required to supply and install the inductive loop detector described above, complete.

Added 6/6/18

## TRAFFIC SIGNAL LED MODULE SPECIFICATIONS

The material requirement shall be in accordance with Sections 880 and 1078 of the Standard Specifications except as modified herein.

The LED assemblies for the red, yellow, and green solid and arrow indications shall meet or exceed the following minimum specifications:

### Solid Indication LED Module Specifications

<u>Compliance:</u>	Fully compliant with ITE VTCSH LED Circular Signal Supplement specifications dated and adopted June 27, 2005
<u>Compliance Verification:</u>	Intertek ETL verified compliance – Product must be listed on the “Directory of LED Modules Certified Products” list located on the ETL website at <a href="http://www.intertek.com/lighting/performance-testing/traffic-signals/">http://www.intertek.com/lighting/performance-testing/traffic-signals/</a>
<u>Diameter:</u>	12” (300mm)
<u>Lens:</u>	UV stabilized scratch resistant polycarbonate, tinted red or yellow, clear for green, uniform non-pixelated illumination, Incandescent Appearance
<u>LEDS:</u>	Hi-Flux
<u>Operating Temperature Range:</u>	-40 to +74C (-40 to +165F)
<u>Operating Voltage Range:</u>	80 to 135 V (60Hz AC)
<u>Power Factor (PF):</u>	> 90%
<u>Total Harmonic Distortion (THD):</u>	< 20%
<u>Minimum Voltage Turn-Off:</u>	35V
<u>Turn-On/Turn-Off Time:</u>	<75 ms

Added 6/6/18

<u>Nominal Power:</u>	10.0 W (Red), 18.0W (Yellow), 12.5 W (Green)
<u>Nominal Wavelength:</u>	625-626 nm (Red), 589-590 nm (Yellow), 500-502 nm (Green)
<u>Minimum Maintained Intensity:</u>	365 Cd (Red), 910 Cd (Yellow), 475 Cd (Green)
<u>Standard Conformance:</u>	FCC compliant for electrical noise, MIL-STD-810F for moisture resistance, MIL-STD-883 for mechanical vibration, NEMA TS2 Transient Voltage Protection
<u>Warranty:</u>	5 year replacement (materials, workmanship, and intensity)

Arrow Indication LED Module Specifications (Red, Yellow, Green)

<u>Compliance:</u>	Fully compliant with ITE VTCSH LED Vehicle Arrow Supplement specifications adopted July 1, 2007
<u>Compliance Verification:</u>	Intertek ETL verified compliance – Product must be listed on the “Directory of LED Modules Certified Products” list located on the ETL website at <a href="http://www.intertek.com/lighting/performance-testing/traffic-signals/">http://www.intertek.com/lighting/performance-testing/traffic-signals/</a>
<u>Diameter:</u>	12” (300mm)
<u>Lens:</u>	Clear Frosted, UV stabilized scratch resistant polycarbonate, tinted red or yellow, clear for green, uniform non-pixelated illumination, incandescent appearance, omni-directional
<u>LEDS:</u>	Hi-flux LEDs
<u>Operating Temperature Range:</u>	-40 to +74C (-40 to +165F)
<u>Operating Voltage Range:</u>	80 to 135 V (60Hz AC)
<u>Power Factor (PF):</u>	> 90%
<u>Total Harmonic Distortion (THD):</u>	< 20%

Added 6/6/18

<u>Minimum Voltage Turn-Off:</u>	35V
<u>Turn-On/Turn-Off Time:</u>	<75 ms
<u>Nominal Power:</u>	5.0-7.0 W (Red), 6.0-12.5W (Yellow), 5.0-7.0 W (Green)
<u>Nominal Wavelength:</u>	625-628 nm (Red), 590 nm (Yellow), 500nm (Green)
<u>Minimum Maintained Intensity:</u>	56.8-58.4 Cd (Red), 141.6-146.0 Cd (Yellow), 73.9-76.0 Cd (Green)
<u>Standard Conformance:</u>	FCC compliant for electrical noise, MIL-STD-810F for moisture resistance, MIL-STD-883 for mechanical vibration, NEMA TS2 Transient Voltage Protection
<u>Warranty:</u>	5 year replacement (materials, workmanship, and intensity)

Arrow Indication LED Module Specifications (Yellow/Green Dual Mode)

<u>Diameter:</u>	12" (300mm)
<u>LEDS:</u>	Interconnected to minimize the effect of single LED failures
<u>Lens:</u>	Clear UV stabilized scratch resistant polycarbonate, uniform non-pixelated illumination, incandescent appearance
<u>Operating Temperature Range:</u>	-40 to +74C (-40 to +165F)
<u>Operating Voltage Range:</u>	80 to 135 V (60Hz AC)
<u>Power Factor (PF):</u>	> 90%
<u>Total Harmonic Distortion (THD):</u>	< 20%
<u>Minimum Voltage Turn-Off:</u>	35V

Added 6/6/18

<u>Turn-On/Turn-Off Time:</u>	<75 ms
<u>Nominal Power:</u>	8.0-10.0 W (Yellow), 8.0-10.0 W (Green)
<u>Nominal Wavelength:</u>	590-592 nm (Yellow), 505-508 nm (Green)
<u>Minimum Maintained Intensity:</u>	141.6-146.0 Cd (Yellow), 73.9-76.0 Cd (Green)
<u>Standard Conformance:</u>	FCC compliant for electrical noise, MIL-STD-810F for moisture resistance, MIL-STD-883 for mechanical vibration, NEMA TS2 Transient Voltage Protection
<u>Warranty:</u>	5 year replacement (materials, workmanship, and intensity)

16" Pedestrian LED Module Specifications (Man/Hand with Countdown Timer)

<u>Compliance:</u>	Fully compliant with ITE PTCSI Part-2 LED Pedestrian Traffic Signal Modules specification adopted August 4, 2010
<u>Compliance Verification:</u>	Intertek ETL verified compliance – Product must be listed on the “Directory of LED Modules Certified Products” list located on the ETL website at <a href="http://www.intertek.com/lighting/performance-testing/traffic-signals/">http://www.intertek.com/lighting/performance-testing/traffic-signals/</a>
<u>Size:</u>	16" x 18"
<u>Configuration:</u>	Man/Hand Overlay with Countdown Timer
<u>Lens:</u>	UV stabilized scratch resistant polycarbonate, uniform non-pixelated illumination, incandescent appearance
<u>Operating Temperature Range:</u>	-40 to +74C (-40 to +165F)
<u>Operating Voltage Range:</u>	80 to 135 V (60Hz AC)
<u>Power Factor (PF):</u>	> 90%

Added 6/6/18

Total Harmonic Distortion (THD):	< 20%
Minimum Voltage Turn-Off:	35V
Turn-On/Turn-Off Time:	<75 ms
Nominal Power:	6.0-9.0 W (Man), 7.0-9.0W (Hand), 5.0-8.0 W (Timer)
Minimum Maintained Intensity:	1,400 Cd (Hand), 1,400 Cd (Timer), 2,200 Cd (Man)
Standard Conformance:	FCC compliant for electrical noise, MIL-STD-810F for moisture resistance, MIL-STD-883 for mechanical vibration, NEMA TS2 Transient Voltage Protection
Warranty:	5 year replacement (materials, workmanship, and intensity)

### **SIGNAL HEAD, LED**

This work shall be in accordance with Sections 880 and 1078 of the Standard Specifications except as modified herein.

The traffic signal heads shall consist of 12" polycarbonate sections and shall be equipped with LED assemblies for all red bulb, yellow bulb, green bulb, red arrow, yellow arrow, and green arrow indications.

The Contractor shall remove the existing traffic signal heads complete with backplates and bracketing and dispose of them off of the right of way. Prior to disposal, the Contractor shall remove all LED modules and recycle them at a certified electronics recycling facility.

The traffic signal heads shall have a yellow finish with black doors and tunnel visors.

The LED signal faces shall be equipped with spade connectors and connected to the traffic signal head terminal block.

The LED modules shall conform to the specifications listed under the section TRAFFIC SIGNAL LED MODULE SPECIFICATIONS.

Added 6/6/18

All costs associated with furnishing and installing new signal head bracketing shall be included in the cost of this pay item. The Contractor shall minimize the total number of holes drilled in a mast arm to no more than three.

Basis of Payment: This work will be paid for at the contract unit prices each for SIGNAL HEAD, LED of the type specified and will be payment in full for all labor, equipment, and materials required to remove the existing signal heads and bracketing and furnish and install traffic signal heads equipped with LED indications and new bracketing as described above, complete.

### **TRAFFIC SIGNAL BACKPLATE, RETROREFLECTIVE**

This work shall be in accordance with Sections 882 and 1078 of the Standard Specifications except as modified herein.

The traffic signal backplates shall be of the same material as the traffic signal heads as specified on the plans.

A three (3) inch wide strip of reflective sheeting shall be applied to the outside perimeter of the face of the backplates. The reflective tape shall be fluorescent yellow in color and shall consist of type AZ sheeting.

Basis of Payment: This work will be paid for at the contract unit price each for TRAFFIC SIGNAL BACKPLATE, RETROREFLECTIVE and shall be payment in full for all labor, materials, and equipment required to furnish and install a traffic signal backplate with reflective tape as described above, complete.

### **TRAFFIC SIGNAL POST, GALVANIZED STEEL, 15 FT.**

This work shall be in accordance with Sections 878 and 1077 of the Standard Specifications except as modified herein.

The traffic signal post shall be attached to the foundation with four 3/4" x 18" galvanized anchor bolts. The post base shall be secured to the foundation using galvanized nuts and galvanized steel flat washers that have a minimum thickness of 1/4" and are trapezoidal in shape. The washers shall be sized to completely capture the mounting flanges of the traffic signal base. Round washers will not be acceptable.

Basis of Payment: This work will be paid for at the contract unit price each for TRAFFIC SIGNAL POST, GALVANIZED STEEL, 15 FT. which price shall be payment in full for all labor, material, and equipment required to provide and install the traffic signal post and base described above.

Added 6/6/18



## **TRAFFIC SIGNAL BATTERY BACKUP SYSTEM**

The following models of Battery Backup Systems are approved for use within District Four:

Alpha Technologies Novus XFM 1100 (with standard IDOT cabinet or Alpha Technologies Side Mount 6 Integrated BBS Cabinet), Equipped with Ethernet SNMP Interface and Enhanced Capability Battery Monitoring System (AlphaGuard Plus)

Techpower Development DBL 1000MX. Equipped with Ethernet Communications Module

Multilink, EP 2200-T, 1500 Watts/2 kVA, 48 Volt, Equipped with Internal Communication Card and Monitoring Software

The Contractor may elect to submit an alternate product for consideration if it meets the minimum requirements contained in this specification.

The Contractor shall be responsible for providing Battery Backup Systems that are sized appropriately for the intersection load. The total system load shall not exceed the manufacturer's specifications.

The battery backup systems for the existing traffic signal cabinets shall be installed as shown on the plan detail sheets and as follows:

- A separate circuit breaker shall be installed in the battery backup system cabinet (or in the traffic signal cabinet). The circuit breaker shall be rated equivalent to the main power circuit breaker rating in the existing traffic signal cabinet. The Contractor shall install #6 wiring from the test circuit breaker to the line voltage in the traffic signal cabinet. The circuit breaker shall be used to shut off the incoming utility power to test the battery backup system.
- The cabinet light, ventilation fans, heater strips, and service receptacle shall be wired to a separate circuit that will not be powered by the battery backup system
- A hole of sufficient size for the cables will be drilled into the side of the cabinet to accommodate the battery backup system cables and harnesses from the BBS cabinet. The hole shall be free of sharp edges and equipped with a plastic or rubber grommet.
- The fail safe automatic by-pass switch and blue indicator light shall be installed in the battery backup cabinet (or in the existing traffic signal cabinet).

Added 6/6/18

**GENERAL REQUIREMENTS:** The Battery Back-up System (BBS) shall include, but not be limited to the following: inverter/charger, power transfer relay, batteries, battery cabinet, a separate failsafe automatic bypass switch and all necessary hardware and interconnect wiring. The BBS shall provide reliable emergency power to a traffic signal in the event of a power failure or interruption. The transfer from utility power to battery power and vice versa shall not interfere with the normal operation of traffic controller, conflict monitor/malfunction management unit or any other peripheral devices within the traffic controller assembly.

The BBS shall provide power for full run-time operation for an “LED-only” intersection (all colors red, yellow, and green) or flashing mode operation for an intersection using Red LED’s. As the battery reserve capacity reaches 50%, the intersection shall automatically be placed in all-red flash. The BBS shall allow the controller to automatically resume normal operation after the power has been restored. The BBS shall log an alarm in the controller for each time it is activated.

All 48-volt Battery Backup Systems shall include four batteries and all 36-volt Battery Backup Systems shall include six batteries.

The BBS shall be designed for outdoor applications, and shall meet the environmental requirements of, “NEMA Standards Publication No. TS 2 – Traffic Controller Assemblies,” or applicable successor NEMA specifications, except as modified herein.

The BBS shall conform to the following specifications:

#### 1.1 OPERATION

- 1.1 The BBS shall be on line and provide voltage regulation and power conditioning when utilizing utility power.
- 1.2 The BBS shall provide a minimum two (2) hours of full run-time operation and four (4) hours all-red flash operation for an “LED-only” intersection (minimum 1000W/1000VA active output capacity, with 80% minimum inverter efficiency).
- 1.3 The maximum transfer time from loss of utility power to switchover to battery backed inverter power shall be 150 milliseconds.
- 1.4 The BBS shall provide the user with 4-sets of normally open (NO) and normally closed (NC) single-pole double-throw (SPDT) relay contact closures, available on a panel-mounted terminal block, rated at a minimum 120V/1A, and labeled to identify each contact. For typical configuration, see the plan detail sheet.

Added 6/6/18

- 1.5 A first set of NO and NC contact closures shall be energized whenever the unit switches to battery power. Contact shall be labeled or marked "On Batt."
- 1.6 The second set of NO and NC contact closures shall be energized whenever the battery approaches approximately 40% of remaining useful capacity. Contact shall be labeled or marked "Low Batt."
- 1.7 The third set of NO and NC contact closures shall be energized two hours after the unit switches to battery power. Contact shall be labeled or marked "Timer."
- 1.8 The fourth set of NO and NC contact closures shall be energized in the event of inverter/charger failure, battery failure or complete battery discharge. Contact shall be labeled or marked "BBS Fail or Status."
- 1.9 A surge suppression unit shall be provided for the output power if available as an option by the BBS manufacturer.
- 1.10 Operating temperature for both the inverter/power transfer relay and failsafe automatic bypass switch shall be  $-37^{\circ}\text{C}$  to  $+74^{\circ}\text{C}$ .
- 1.11 The Power Transfer Relay shall be rated at 240VAC/30AMPS minimum and failsafe automatic bypass switch shall be rated at 240VAC/20 amps, minimum.
- 1.12 The fail safe automatic bypass switch shall be wired to provide power to the BBS when the switch is set to bypass.
- 1.13 The BBS shall use a temperature-compensated battery charging system. The charging system shall compensate over a range of  $2.5 - 4.0 \text{ mV}/^{\circ}\text{C}$  per cell.
- 1.14 The temperature sensor shall be external to the inverter/charger unit. The temperature sensor shall come with 2 meters (6'6") of wire.
- 1.15 Batteries shall not be recharged when battery temperature exceeds  $50^{\circ}\text{C} \pm 3^{\circ}\text{C}$ .
- 1.16 BBS shall bypass the utility line power whenever the utility line voltage is outside of the following voltage range: 100VAC to 130VAC ( $\pm 2\text{VAC}$ ).
- 1.17 When utilizing battery power, the BBS output voltage shall be between 110 VAC and 125 VAC, pure sine wave output,  $\pm 3\%$  THD,  $60\text{Hz} \pm 3\text{Hz}$ .
- 1.18 BBS shall be compatible with Illinois DOT's traffic controller assemblies utilizing NEMA TS 1 or NEMA TS 2 controllers and cabinet components for full time operation.

Added 6/6/18

- 1.19 When the utility line power has been restored at above 105 VAC  $\pm$  2 VAC for more than 30 seconds, the BBS shall dropout of battery backup mode and return to utility line mode.
- 1.20 When the utility line power has been restored at below 125VAC  $\pm$  2 VAC for more than 30 seconds, the BBS shall dropout of battery backup mode and return to utility line mode.
- 1.21 BBS shall be equipped to prevent a malfunction feedback to the cabinet or from feeding back to the utility service.
- 1.22 In the event of inverter/charger failure, battery failure or complete battery discharge, the power transfer relay shall revert to the NC state, where utility line power is reconnected to the cabinet. The BBS shall always revert to utility line power and shall be designed to revert to utility line power in the event of a BBS fault condition.
- 1.23 Recharge time for the battery, from "protective low-cutoff" to 80% or more of full battery charge capacity, shall not exceed twenty (20) hours.
- 1.24 When the intersection is in battery operation, the BBS shall bypass all internal cabinet lights, ventilation fans, heater strips, and service receptacles.
- 1.25 The fail safe automatic bypass switch shall be wired to provide power to the BBS when the switch is set to bypass.
- 1.26 A blue LED indicator light shall be mounted on the front of the traffic signal cabinet or on the side of the BBS cabinet facing traffic and shall turn on to indicate when the cabinet power has been disrupted and the BBS is in operation. The light shall be a minimum 1" diameter, be viewable from the driving lanes, and shall be large enough and visible enough to be seen from 200 ft. away.
- 1.27 All 36-volt and 48-volt systems shall include an external component that monitors battery charging to ensure that every battery in the string is fully charged. The device shall compensate for the effects of adding a new battery to an existing battery system by ensuring that the charge voltage is spread equally across all batteries. All cables, harnesses, cards, and other components that are required to provide the functionality described above shall be included in the unit bid price for the battery backup system. The following products are currently approved for use within District 4: Alpha Technologies: AlphaGuard with Charge Management Technology Module and Approved Equivalent

Added 6/6/18

1.28 The BBS shall be equipped with an integrated safety switch that will interrupt inverter output power in the event of a cabinet knockdown. The safety switch may be either internal to the inverter/charger or externally mounted inside of the BBS cabinet. The safety switch shall be designed to interrupt output power in the event that the charger/inverter is tilted more than twenty degrees on any axis. The switch shall be mechanically latching to ensure that power is not automatically restored to the BBS until the charger/inverter has been "reset". The switch shall also be resettable and reusable unless it has been physically damaged.

1.29 The BBS shall be equipped with an Ethernet port and network management card.

## 2.0 MOUNTING AND CONFIGURATION

### 2.1 GENERAL

2.2 Inverter/Charger Unit shall be rack or shelf-mounted.

2.3 (Reserved).

2.4 All interconnect wiring provided between Power Transfer Relay, Bypass Switch and Cabinet Terminal Service Block shall be no greater than two (2) meters (6'6") of #10 AWG wire.

2.5 Relay contact wiring provided for each set of NO/NC relay contact closure terminals shall be #18 AWG wire.

2.6 All necessary hardware for mounting (shelf angles, rack, etc) shall be included in the bid price of the BBS. The swing-trays shall be screwed to the Type IV or Type V NEMA cabinets using continuous stainless steel or aluminum piano hinge. All bolts/fasteners and washers shall be 1/2" diameter galvanized or stainless steel.

## 3.0 EXTERNAL BATTERY CABINET

3.1 The external cabinet shall be a rated NEMA Type 3R Cabinet.

3.2 Inverter/Charger and Power Transfer Relay shall be installed inside the external battery cabinet and the failsafe automatic bypass switch shall be installed inside the existing traffic signal cabinet or proposed battery backup cabinet.

3.3 Batteries shall be housed in the external cabinet which shall be NEMA Standard rated cabinet mounted to the side of the Type IV or Type V Cabinet (see plan sheets for details). This external battery cabinet shall conform to the IDOT Standard Specifications for traffic signal cabinets for the construction and finish of the cabinet.

Added 6/6/18

- 3.4 The external battery cabinet shall mount to the Type IV or Type V NEMA Cabinet with a minimum of four (4) bolts to the satisfaction of the Engineer.
- 3.5 The dimensions of the external battery cabinet shall be 25" (L) x 16" (W) x 41" (H) and installed in accordance with the plan sheet cabinet detail and this specification.
- 3.6 The cabinet shall include heater mats for each battery shelf and/or battery. If the BBS charger/inverter does not have facilities to accommodate heater mat connections, thermostatically controlled heater mats shall be provided with the system. The heater mat thermostat shall be a separate thermostat (from the ventilation fan thermostat) and be adjustable from 0°F to 32°F for heater mat turn-on.
- 3.7 A warning sticker shall be placed on the outside of the cabinet indicating that there is an Uninterruptible Power Supply inside the cabinet.
- 3.8 The external battery cabinet shall be ventilated through the use of louvered vents (2), filters, and one thermostatically controlled fan as per NEMA TS 2 Specifications. The cabinet shall include a cleanable or replaceable cabinet filter.
- 3.9 External battery cabinet fan shall be AC operated from the same line output of the bypass Switch that supplies power to the Type IV or Type V Cabinet.
- 3.10 The BBS with external battery cabinet shall come with all bolts, conduits and bushings, gaskets, shelves, and hardware needed for mounting. The external battery cabinet shall have a hinged door opening to the entire cabinet. The cabinet shall include a bottom constructed from the same material as the cabinet.
- 3.11 The external cabinet shall be equipped with a power receptacle to accommodate the inverter/charger. The receptacle shall be wired to the line output of the manual bypass switch.
- 4.0 MAINTENANCE, DISPLAYS, CONTROLS AND DIAGNOSTICS
- 4.1 The BBS shall include a display and /or meter to indicate current battery charge status and conditions.
- 4.2 The BBS shall have lightning surge protection compliant with IEEE/ANSI C.62.41.
- 4.3 The BBS shall be equipped with an integral system to prevent battery from destructive discharge and overcharge.
- 4.4 The BBS and batteries shall be easily replaced with all needed hardware and shall not require any special tools for installation.

Added 6/6/18

- 4.5 The BBS shall be equipped with a RS-232 port.
- 4.6 The BBS shall include a resettable front-panel event counter display to indicate the number of times the BBS was activated and a front-panel hour meter to display the total number of hours the unit has operated on battery power.
- 4.7 Manufacturer shall include two (2) sets of equipment lists, operation and maintenance manuals, and board-level schematic and wiring diagrams of the BBS, and the battery data sheets. Manufacturer shall include any software needed to monitor, diagnose, and operate the BBS. The manufacturer shall include any required cables to connect to a laptop computer.
- 4.8 The BBS shall include a data cable for the serial connection to the RS232 port and diagnostic software if it is available as an option with the unit (only two cables required for project).
- 4.9 One copy of the owner/maintenance manuals shall be provided with the BBS.

4.1 BATTERY SYSTEM

- 4.2 Individual batteries shall be 12V type and shall be easily replaced and commercially available off the shelf.
- 4.3 The batteries shall be premium gel type with a 5 year full replacement warranty.
- 4.4 Batteries used for BBS shall consist of a minimum of four (4) to eight (8) batteries with a cumulative minimum rated capacity of 280 amp-hours.
- 4.5 Batteries shall be deep cycle, completely sealed, silver alloy VRLA (Valve Regulated Lead Acid) requiring no maintenance with maximum run time.
- 4.6 Batteries shall be certified by the manufacturer to operate over a temperature range of – 40°C to +71°C.

Added 6/6/18

- 4.7 The batteries shall be provided with appropriate interconnect wiring and corrosion-resistant mounting trays and/or brackets appropriate for the cabinet into which they will be installed.
- 4.8 Batteries shall indicate maximum recharge data and recharging cycles.
- 4.9 Battery interconnect wiring shall be via modular harness. Batteries shall be shipped with positive and negative terminals pre-wired with red and black cabling that terminates into a typical power-pole style connector. Harness shall be equipped with mating power-pole style connectors for batteries and a single, insulated plug-in style connection to inverter/charger unit. Harness shall allow batteries to be quickly and easily connected in any order and shall be keyed and wired to ensure proper polarity and circuit configuration.
- 4.10 Battery terminals shall be covered and insulated to prevent accidental shorting.

#### 6.0 QUALITY ASSURANCE

- 6.1 BBS shall be manufactured in accordance with a manufacturer quality assurance (QA) program. The QA program shall include two types of quality assurance: (1) Design quality assurance and (2) Production quality assurance. The production quality assurance shall include statistically controlled routine tests to ensure minimum performance levels of BBS units built to meet this specification and a documented process of how problems are to be resolved.
- 6.2 QA process and test results documentation shall be kept on file for a minimum period of seven years.
- 6.3 Battery Backup System designs not satisfying design qualification testing and the production quality assurance testing performance requirements described below shall not be labeled, advertised, or sold as conforming to this specification.

#### 7.0 DESIGN QUALIFICATION TESTING

- 7.1 The manufacturer, or an independent testing lab hired by the manufacturer, shall perform design Qualification Testing on new BBS designs, and when a major design change has been implemented on an existing design. A major design change is defined as a design change (electrical or physical) which changes any of the performance characteristics of the system, or results in a different circuit configuration.
- 7.2 Burn In. The sample systems shall be energized for a minimum of 5 hours, with full load of 700 watts, at temperatures of +74°C and -37°C., excluding batteries, before performing any design qualification testing.

Added 6/6/18



- 7.3 Any failure of the BBS, which renders the unit non-compliant with the specification after burn-in, shall be cause for rejection.
- 7.4 For Operational Testing, all specifications may be measured including, but not limited to:
- 7.5 Run time while in battery backup mode, at full load.
- 7.6 Proper operation of all relay contact closures (“On-Batt”, “Low-Batt”, “Timer” and “BBS-Fail”).
- 7.7 Inverter output voltage, frequency, harmonic distortion, and efficiency, when in battery backup mode.
- 7.8 All utility mode – battery backup mode transfer voltage levels. See Section 1 Operation.
- 7.9 Power transfer time from loss of utility power to switchover to battery backed inverter power.
- 7.10 Backfeed voltage to utility when in battery backup mode.
- 7.11 IEEE/ANSI C.62.41 compliance.
- 7.12 Battery charging time.
- 7.13 Event counter and runtime meter accuracy.

#### 8.0 PRODUCTION QUALITY CONTROL TESTING

- 8.1 Production Quality Control tests shall consist of all of the above listed tests and shall be performed on each new system prior to shipment. Failure to meet requirements of any of these tests shall be cause for rejection. The manufacturer shall retain test results for seven years.
- 8.2 Each BBS shall be given a minimum 100-hour burn-in period to catch any premature failures.
- 8.3 Each system shall be visually inspected for any exterior physical damage or assembly anomalies. Any defects shall be cause for rejection.

Added 6/6/18

9.0 WARRANTY

- 9.1 Manufacturers shall provide a minimum two (2) year factory-repair warranty for parts and labor on the BBS from date of acceptance by the State. Batteries shall be warranted for full replacement for five (5) years from date of purchase. The warranty shall be included in the total bid price of the BBS.
- 9.2 The Contractor shall furnish a warranty certificate for each Battery Backup System that includes the equipment description and details, serial numbers, effective dates, and the details of the warranty regarding materials and labor. The warranty period shall begin on the date of installation and the warranty certificate shall reflect this date.

Basis of Payment: The above work will be paid for at the contract unit price each for TRAFFIC SIGNAL BATTERY BACKUP SYSTEM shall be payment in full for all labor, materials, and equipment required to provide, install, and test the battery backup system described above, complete.

**CLOSED-CIRCUIT TELEVISION DOME CAMERA, IP BASED**

Description. This work shall consist of furnishing and installing an integrated Closed-Circuit Television (CCTV) Dome Camera Assembly, camera brackets, and all other items required for installation and operation. This assembly shall contain all components identified in the Materials Section and shall be configured as indicated on the plan sheets.

Materials.

The CCTV camera shall be an Axis Model Q6052-E Dome Camera Assembly for integration into the existing ITS system.

The Contractor shall provide all materials required to install the proposed camera on the proposed combination mast arm assembly as shown on the plan sheets.

The Contractor shall submit catalog cut sheets to the Department for all items (mounting brackets, hardware, etc.) that will be utilized for review prior to commencing work.

The Department will program the cameras.

Added 6/6/18

The camera shall meet or exceed the following specifications:

CAMERA

- VIDEO: 60 Hz (NTSC), 50 Hz (PAL)
- IMAGE SENSOR: 1/2.8" Progressive Scan CMOS
- LENS: 3.3–119 mm, F1.4–4.2, Horizontal field of view: 47.0°–1.5°  
Vertical field of view: 35.5°–1.1°  
Autofocus, auto-iris
- DAY AND NIGHT: Automatically removable infrared-cut filter
- MINIMUM ILLUMINATION: Color: 0.15 lux at 30 IRE F1.4, Color: 0.25 lux at 50 IRE F1.4  
B/W: 0.008 lux at 30 IRE
- SHUTTER TIME: NTSC: 1/30000 s to 1/0.75 s with 50 Hz  
1/30000 s to 1.0 s with 60 Hz
- PAN/TILT/ZOOM: Pan: 360° endless, 0.05° - 450°/s, Tilt: 220°, 0.05°-450°/s  
36x optical zoom and 12x digital zoom, total 432x zoom  
E-flip, 256 preset positions, Tour recording, Guard tour, Control  
queue, On-screen directional indicator, Set new pan 0°,  
Adjustable zoom speed

VIDEO

- VIDEO COMPRESSION: H.264 (MPEG-4 Part 10/AVC) Baseline, Main and High Profiles  
Motion JPEG
- RESOLUTIONS: NTSC: 704x480 to 176x120, PAL: 704x576 to 176x144
- FRAME RATE: Up to 50/60 fps (50/60 Hz) in all resolutions  
Capture mode PAL: Up to 50 fps in all resolutions  
Capture mode NTSC: Up to 60 fps in all resolutions
- VIDEO STREAMING: Multiple, individually configurable streams in H.264 and Motion  
JPEG, Axis Zipstream technology, Controllable frame rate and  
bandwidth, VBR/MBR H.264

Added 6/6/18

IMAGE SETTING: Manual shutter time, compression, color, brightness, sharpness, white balance, exposure control, exposure zones, fine tuning of behavior at low light, rotation: 0°, 180°, text and image overlay, 32 individual 3D privacy masks, image freeze on PTZ, automatic defog, backlight compensation  
Electronic Image Stabilization (EIS)  
Wide Dynamic Range (WDR): 110 dB, shadows and highlights Recovery

## NETWORK

SECURITY: Password protection, IP address filtering, HTTPS\* encryption, IEEE 802.1X\* network access control, digest authentication, user access log, Centralized Certificate Management

PROTOCOLS: IPv4/v6, HTTP, HTTPSa, SSL/TLSa, QoS Layer 3 DiffServ, FTP, CIFS/SMB, SMTP, Bonjour, UPnP, SNMP v1/v2c/v3 (MIB-II), DNS, DynDNS, NTP, RTSP, RTP, SRTP, SFTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS, SSH, NTCIP, LLDP

## SYSTEM INTEGRATION

APPLICATION PROG INTERFACE Open API for software integration, including VAPIX® and AXIS Camera Application Platform; specifications at [www.axis.com](http://www.axis.com)  
AXIS Video Hosting System (AVHS) with One-Click Connection  
ONVIF® Profile S and ONVIF® Profile G, specification at [onvif.org](http://onvif.org)

ANALYTICS: AXIS Video Motion Detection, Autotracking, Active Gatekeeper, AXIS Fence Guard, AXIS Motion Guard  
Support for AXIS Camera Application Platform enabling installation of third-party applications, see [www.axis.com/acap](http://www.axis.com/acap)

EVENT TRIGGERS: Detectors: live stream accessed, video motion detection, shock detection  
Hardware: fan, network, temperature, casing open  
PTZ: autotracking, error, moving, ready, preset reached  
Storage: disruption, recording  
System: system ready  
Time: recurrence, use schedule  
Input signal: manual trigger, virtual input

Added 6/6/18

EVENT ACTIONS: Day/night mode, overlay text, video recording to edge storage, pre- and post-alarm video buffering, send SNMP trap  
PTZ: PTZ preset, start/stop guard tour  
File upload via FTP, SFTP, HTTP, HTTPS network share and email  
Notification via email, HTTP, HTTPS and TCP

DATA STREAMING: Event data

BUILT-IN INSTALLATION AIDS Pixel counter

### GENERAL

CASING: IP66-, NEMA 4X- and IK10-rated  
Metal casing (aluminum), polycarbonate (PC) clear dome, sunshield (PC/ASA)

SUSTAINABILITY: PVC FREE

MEMORY: 512 MB RAM, 256 MB FLASH

POWER: Axis High PoE midspan 1-port: 100–240 V AC, max 74 W  
Camera consumption: typical 16 W, max 60 W

CONNECTORS: RJ45 10BASE-T/100BASE-TX PoE, RJ45 Push-pull Connector (IP66) included

STORAGE: Support for SD/SDHC/SDXC card  
Support for SD card encryption  
Support for recording to network-attached storage (NAS)

OPERATING CONDITIONS: With 60 W midspan: -50 °C to 50 °C (-58 °F to 122 °F)  
Maximum temperature (intermittent): 60 °C (140 °F)  
Arctic Temperature Control: Start-up as low as -40 °C (-40 °F)  
Humidity 10–100% RH (condensing)

STORAGE CONDITIONS: -40 °C TO 65 °C (-40 °F TO 149 °F)

Added 6/6/18

APPROVALS:	EMC: EN 55022 Class A, EN 61000-3-2, EN 61000-3-3, EN 61000-6-1, EN 61000-6-2, EN 55024, FCC Part 15 Subpart B Class A, ICES-003 Class A, VCCI Class A, RCM AS/NZS CISPR 22 Class A, KCC KN32 Class A, KN35  Safety, IEC/EN/UL 60950-1, IEC/EN/UL 60950-22  Environment: EN 50121-4, IEC 62236-4, IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-6, IEC 60068-2-14, IEC 60068-2-27, NEMA 250 Type 4X, IEC/EN 60529 IP66, IEC 60721-4-3, IEC 60068-2-30, IEC 60068-2-60, IEC 60068-2-78, NEMA TS-2-2003 v02.06, Subsection 2.2.7, 2.2.8, 2.2.9; IEC 62262 IK10, ISO 4892-2  Midspan: EN 60950-1, GS, UL, cUL, CE, FCC, VCCI, CB, KCC, UL-AR
WEIGHT	3.7 kg (8.2 lb.)
INCLUDED ACCESSORIES	Axis High PoE 60 W midspan 1-port, RJ45 Push-pull Connector (IP66), Sunshield, Installation Guide, Windows decoder 1-user license
WARRANTY:	Axis 3-year warranty

Environmental Enclosure/Housing

The environmental enclosure shall be designed to physically protect the integrated camera from the outdoor environment and moisture via a sealed enclosure. If the option exists in the standard product line of the manufacturer, the assembly shall be supplied with an integral sun shield. The enclosure shall be fully water and weather resistant with a NEMA 4 rating or better.

The camera dome shall be constructed of distortion free acrylic or equivalent material that must not degrade from environmental conditions. The environmental housing shall include a camera-mounting bracket. In addition, the environmental housing shall include a heater, blower, and power surge protector. An integral fitting compatible with a standard 1-1/2 in (38.1 mm) NPT pipe, suitable for outdoor pendant mounting shall also be provided.

Added 6/6/18

The enclosure shall be equipped with a heater controlled by a thermostat. The heater shall turn on when the temperature within the enclosure falls below 40° F (4.4°C). The heater shall turn off when the temperature exceeds 60°F (15.6°C). The heater will minimize internal fogging of the dome faceplate when the assembly is operated in cold weather.

In addition, a fan shall be provided as part of the enclosure. The fan will provide airflow to ensure effective heating and to minimize condensation.

The enclosure shall be equipped with a hermetically sealed, weatherproof connector, located near the top for external interface with power, video, and control feeds.

#### CCTV Dome Camera Mounting Supports

The Contractor shall furnish and install an Axis Pole Mount Bracket T91G61 for camera installation on traffic signal mast arms and CCTV camera poles and stainless-steel banding as required.

Mounting supports shall be configured as shown on the camera support detail plans and as approved by the Engineer. Mount shall be of aluminum construction with enamel or polyester powder coat finish. Braces, supports, and hardware shall be stainless steel. Wind load rating shall be designed for sustained gusts up to 90 mph (145 km/hr), with a 30% gust factor. Load rating shall be designed to support up to 75 lb (334 N). For roof or structural post/light pole mounting, mount shall have the ability to swivel inward for servicing. The mounting flange shall use standard 1-1/2 inch (38.1 mm) NPT pipe thread.

#### Connecting Cables

The Contractor shall provide outdoor rated, shielded, gel-filled CAT 5E cable. The cable shall be terminated using the IP66 rated RJ-45 connector on the camera end and a standard RJ-45 connector in the cabinet. The Contractor shall test the cable prior after termination. The cable will be paid for separately under the pay item for CAT 5 ETHERNET CABLE.

#### Construction Requirements.

##### General

The Contractor shall prepare a shop drawing detailing the complete CCTV Dome Camera Assembly and installation of all components to be supplied for approval of the Engineer. Particular emphasis shall be given to the cabling and the interconnection of all of the components.

The Contractor shall install the CCTV dome camera assembly at the locations indicated in the Plans. The CCTV Dome Camera Assembly shall be mounted on a pole, wall, or other structure.

Added 6/6/18

### Testing

The Contractor shall test each installed CCTV Dome Camera Assembly. The test shall be conducted from the field cabinet using the standard communication protocol and a laptop computer. The Contractor shall verify that the camera can be fully exercised and moved through the entire limits of Pan, Tilt, Zoom, Focus and Iris adjustments, using both the manual control and presets. The Contractor shall maintain a log of all testing and the results. A representative of the Contractor and a representative of the Engineer shall sign the log as witnessing the results. Records of all tests shall be submitted to the Engineer prior to accepting the installation.

Method of Measurement. The closed circuit television dome camera bid item will be measured for payment by the actual number of CCTV dome camera assemblies furnished, installed, tested, and accepted.

Basis of Payment. Payment will be made at the contract unit price for each CLOSED CIRCUIT TELEVISION DOME CAMERA, IP BASED including all equipment, material, testing, documentation, and labor detailed in the contract documents for this bid item.

### **CAT 5 ETHERNET CABLE**

This work shall be in accordance with Sections 873, 1076, and 1088 of the Standard Specifications except as modified herein.

This work shall consist of furnishing and installing an outdoor rated CAT5E cable in conduits, handholes, and poles.

The cable shall be rated for outdoor use and conform to the following specifications:

- Outdoor CMX Rated Jacket (climate/oil resistant jacket)
- UV Resistant Outer Jacket Material (PVC-UV, UV Stabilized)
- Outer Jacket Ripcord
- Designed For Outdoor Above- Ground or Conduit Duct applications
- Cat5E rated to 350MHz (great for 10/100 or even 1000mbps Gigabit Ethernet)
- Meets TIA/EIA 568b.2 Standard
- Unshielded Twist Pair
- 4 Pairs, 8 Conductors
- 24AWG, Solid Core Copper
- Shielded
- UL 444 ANSI TIA/EIA-568.2 ISO/IEC 11801
- RoHS Compliant

Basis of Payment: This work will be paid for at the contract unit price per foot for CAT 5 ETHERNET CABLE, which shall be payment in full for all labor, equipment, and materials required to provide and install the cable described above, complete.

Added 6/6/18



## **LUMINAIRE, LED, HORIZONTAL MOUNT, OF THE WATTAGE SPECIFIED**

**Description:** This work consists of removing and disposing of an existing luminaire and furnishing all materials, equipment, and labor necessary to install Light-Emitting Diode (LED) luminaires as shown on the plans, in accordance with the applicable requirements of Section 821 of the Standard Specifications for Road and Bridge Construction, and as specified herein.

**General:** The luminaire shall be assembled in the continental U.S.A. and shall be assembled by and manufactured by the same Manufacturer. Quick connect/disconnect plugs shall be supplied between the discrete electrical components within the luminaire such as the driver, surge protection device, and optical assembly for easy removal. The quick connect/disconnect plugs shall be operable without the use of tools and while wearing insulated gloves. The luminaire shall be in compliance with ANSI C136.37. LED light source(s) and driver(s) shall meet the material requirements of the Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU.

**Manufacturer Experience.** The luminaire shall be designed to be incorporated into a lighting system with an expected 30-year lifetime. The luminaire Manufacturer shall have a minimum of 30 years' experience manufacturing High Intensity Discharge (HID) roadway luminaires and shall have a minimum of 5 years' experience manufacturing LED roadway luminaires. The Manufacturer shall have a minimum of 5,000 total LED roadway luminaires installed on a minimum of 30 separate installations, all within the continental U.S.A.

**Housing:** The housing shall be designed to ensure maximum heat dissipation and to prevent the accumulation of water, ice, dirt and debris. A passive cooling method with no moving or rotating parts shall be employed for heat management. The effective projected area of the luminaire shall not exceed 1.4 sq. ft. The total weight of the luminaire(s) and accessories shall not exceed 75 pounds. Wiring within the electrical enclosure shall be rated at 600 V, 221°F (105°C) or higher.

**Finish.** Painted or finished luminaire surfaces exposed to the environment, shall exceed a rating of six according to ASTM D1654 after 1000 hours of ASTM B117 testing. The coating shall exhibit no greater than 30% reduction of gloss according to ASTM D523, after 500 hours of ASTM G154 Cycle 6 QUV® accelerated weathering testing.

**Attachment.** The luminaire shall slip-fit on a mounting arm with a 2 in. (5 cm) diameter tenon [2.375 in. (6 cm) outer diameter], and shall have a barrier to limit the amount of insertion. The luminaire shall be provided with a leveling surface and shall be capable of being tilted  $\pm 5$  degrees from the axis of attachment in not more than 2.5 degree increments and rotated to any degree with respect to the supporting arm.

Added 6/6/18

Receptacle. The luminaire shall include a fully prewired, 7-pin twist lock ANSI C136.41 compliant receptacle. Unused pins shall be connected as directed by the Manufacturer and as approved by the Engineer. A shorting cap shall be provided with the luminaire.

Vibration Characteristics. All luminaires shall pass ANSI C136.31 requirements. Roadway luminaires mounted on a bridge and high mast luminaires shall be rated for "3G" peak acceleration. Vibration testing shall be run using the same luminaire in all three axes.

Labels and Decals. All luminaires shall have external labels in compliance with the latest version of ANSI C136.15 and internal labels in compliance with the latest version of ANSI C136.22.

The luminaire shall be listed for wet locations by a Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA and shall be in compliance with UL 8750 and UL 1598. It shall be identified as such by the holographic UL tag/sticker on the inside of the luminaire.

Hardware. All external fasteners shall be stainless steel. All hardware shall have corrosion resistance.

**Optical Assembly:** The LED optical assembly, consisting of LED packages, shall have a minimum Ingress Protection rating of IP66 according to ANSI/IEC 60529. Circuiting shall be designed to minimize the impact of individual LED failures on the operation of the other LEDs. The optical assembly shall utilize high brightness, long life, minimum 70 color rendering index (CRI), 4,000 K color temperature (+/-300 K) LEDs binned according to ANSI C78.377. Lenses shall be UV-stabilized acrylic or glass. Provisions for house-side shielding shall be provided when specified.

Lumen depreciation at 50,000 hours of operation shall not exceed 15% of initial lumen output at the specified LED drive current and an ambient temperature of 77°F (25°C).

The assembly shall have individual serial numbers or other means for Manufacturer tracking.

Added 6/6/18

**Photometric Performance:** The classification of LED luminaires shall be as follows:

VLW – Wattages  $\leq$  100, minimum delivered lumens 5,000,  
LW – Wattages 101 - 200, minimum delivered lumens 10,000,  
MW – Wattages 201 - 300, minimum delivered lumens 20,000,  
HW – Wattages 301 - 400, minimum delivered lumens 30,000,  
VHW – Wattages  $\geq$  401, minimum delivered lumens 40,000.

VLW= very low watt, LW = low watt, MW = medium watt, HW = high watt, and VHW = very high watt luminaire. Luminaires with lumens below the stated minimums will not be accepted.

Testing. Luminaires shall be tested according to IES LM-79. The laboratory performing this test shall hold accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) under NIST. Submitted reports shall have a backlight, upright, and glare (BUG) rating according to IESNA TM-15 including a luminaire classification system graph with both the recorded lumen value and percent lumens by zone.

Lumen maintenance shall be measured for the LEDs according to LM-80, or when available for the luminaires according to LM-84. The LM-80 report shall be based on a minimum of 6,000 hours, yet 10,000 hour reports shall be provided for luminaires where those tests have been completed.

Thermal testing shall be provided according to UL 1598. The luminaire shall start and operate in the ambient temperature range specified. The maximum rated case temperature of the driver, LEDs, and other internal components shall not be exceeded when the luminaire is operated in the ambient temperature range specified.

Mechanical design of protruding external surfaces such as heat sink fins shall facilitate hose-down cleaning and discourage debris accumulation. Testing shall be submitted when available to show the maximum rated case temperature of the driver, LEDs, and other internal components are not exceeded when the luminaire is operated with the heat sink filled with debris.

Calculations. Complete point-by-point luminance and veiling luminance calculations as well as listings of all indicated averages and ratios as applicable shall be provided according to IES RP-8 recommendations. Lighting calculations shall be performed using AGI32 software with calculations performed to two decimal places (i.e. x.xx cd/m<sup>2</sup>). Calculation results shall demonstrate that the submitted luminaire meets the lighting metrics specified in the project Luminaire Performance Tables (see exhibit B). Scotopic or mesopic factors will not be allowed.

Added 6/6/18

Lumen Maintenance Projection. The LEDs shall have long term lumen maintenance documented according to IESNA TM-21, or when available for the luminaires according to IESNA TM-28. The submitted calculations shall incorporate an in situ temperature measurement test (ISTMT) and LM-80 data with TM-21 inputs and reports according to the TM-21 calculator, or when available ISTMT and LM-84 data with TM-28 inputs and reports according to the TM-28 calculator. Ambient temperature shall be 77°F (25°C).

**Driver:** The driver for the luminaire shall be integral to the unit. It shall be mounted in the rear of the luminaire on the inside of a removable door or on a removable mounting pad. The removable door or pad shall be secure when fastened in place and all individual components shall be secured upon the removable element. Each component shall be readily removable from the removable door or pad for replacement.

Circuit Protection. Shall tolerate indefinitely open and short circuit output conditions without damage.

Ingress Protection. IP66 rating.

Input Voltage. Shall be suitable for operation over a range of 120 to 277 volts or 347 to 480 volts as required by the system operating voltage.

Operating Temperature. Operating ambient temperature range of -40°F to 104°F (-40°C to 40°C).

Driver Life. Life time of 100,000 hours at 77°F (25°C) ambient.

Safety/UL. Listed under UL 1310 or UL 1012.

Power Factor. Shall maintain a power factor of 0.9 or higher and total harmonic distortion of less than 20 % at 50% load across the full supply voltage range.

Driver efficiency. Minimum efficiency of 90% at maximum load and a minimum efficiency of 85% for the driver operating at 50% power with driver efficiency defined as output power divided by input power.

Electrical Interference. Shall meet the Electromagnetic Compatibility (EMC) requirements for Class A digital devices included in the FCC Rules and Regulations, Title 47, Part 15.

Thermal Fold Back. The driver shall reduce the current to the LED module if the driver is overheating due to abnormal conditions.

Dimming. 0-10 V dimming capability.

Leakage current. Compliance with safety standards according to IEC 61347-1 and UL 1012.

Added 6/6/18

**Surge Protection Device:** SPD shall be labeled as Type 4 in accordance to UL 1449 and be an integral part of the luminaire. It shall provide a minimum system protection level of 10 kV, 10 kA. To protect for a 10 kV, 10 kA surge the required clamping voltage of the external Metal Oxide Varistor (MOV) or other SPD shall be lower than 1 kV at 8 kA  $\{(10 \text{ kV}-2 \text{ kV})/1 \text{ ohm}=8 \text{ kA}\}$ .

The SPD shall comply with the following standards:

- 1) IEEE C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits,
- 2) IEEE C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits,
- 3) IEEE C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits, and
- 4) ANSI C136.2, American National Standard for Roadway and Area Lighting Equipment – Luminaire Voltage Classification.

The SPD and performance parameters shall be posted at [www.UL.com](http://www.UL.com) under Category Code: VZCA2.

**Warranty:** The entire luminaire and all of its component parts shall be covered by a Ten-Year Warranty. Failure is when one or more of the following occur:

- 1) Negligible light output from more than 10 percent of the LED packages
- 2) Condensed moisture inside the optical assembly
- 3) driver that continues to operate at a reduced output below 15% of the rated nominal output

The warranty period shall begin on the date of final acceptance of the lighting work as documented in the Resident Engineer's project notes.

Added 6/6/18

**Submittal Requirements:** The Contractor shall submit, for approval, an electronic version of all associated luminaire IES files, AGi32 files and the TM-21 calculator spreadsheet with inputs and reports associated with the project luminaires. The Contractor shall also provide an electronic version of each of the following Manufacturer's product data for each type of luminaire.

- 1) Descriptive literature and catalogue cuts for luminaire, LED package, driver, and surge protection device.
- 2) LED drive current, total luminaire input wattage and total luminaire current at the system operating voltage or voltage range and ambient temperature of 77°F (25°C).
- 3) Luminaire efficacy expressed in lumens per watt (lpw) per luminaire.
- 4) Initial delivered lumens at the specified color temperature, drive current and ambient temperature.
- 5) Computer photometric calculation reports.
- 6) TM-15 BUG rating report.
- 7) Documentation of Manufacturers experience and certification that luminaires were assembled in the U.S.A.
- 8) Supporting documentation of compliance with ANSI standards as well as listing requirements.
- 9) Supporting documentation of laboratory accreditations and certifications for specified testing.
- 10) Thermal testing documents.
- 11) IES LM-79, LM-80 (or LM-84) and TM-21 (or TM-28) reports.
- 12) Salt spray (fog) test reports and certification.
- 13) Vibration characteristics test reports and certification.
- 14) IP test reports.
- 15) Manufacturer written warranty.
- 16) Luminaire installation, maintenance, and washing instructions.

**Luminaire Testing:** When a contract has 30 or more luminaires of the same type, wattage and distribution, that luminaire shall be tested. The quantity of luminaires requiring testing shall be one luminaire for the first 30 plus one additional luminaire for each additional 50 luminaires of that type, wattage, and distribution. Testing is not required for temporary lighting luminaires. The Contractor shall coordinate the luminaire testing, propose a properly accredited laboratory and an independent witness, submit their qualifications for approval prior to any testing, and pay all associated costs including travel expenses for the independent witness. Delays caused by the luminaire testing process shall not be grounds for additional compensation or extension of time.

The independent witness shall be present when tests are performed by the luminaire manufacturer. A laboratory independent of the luminaire manufacturer, distributor, and Contractor may self-certify the test results, in which case the independent witness need not be present during the testing.

Added 6/6/18

After all qualifications have been approved, the independent witness shall select from the project luminaires at the manufacturer's facility the luminaires for testing. In all cases, the selection of luminaires shall be a random selection from the entire completed lot of luminaires required for the contract. Selections from partial lots will not be allowed. The independent witness shall mark each sample luminaire's shipping carton with the IDOT contract number and a unique sample identifier.

At the time of random selection, the independent witness shall inspect the luminaire(s) for compliance with all physical, mechanical, and labeling requirements for luminaires according to Sections 821 and 1067 and as stated herein. If deficiencies are found during the physical inspection, the Contractor shall have all luminaires of that type, wattage, and distribution inspected for the identified deficiencies and shall correct the problem(s) where found. Random luminaire selection and physical inspection must then be repeated. When the physical inspection is successfully completed, the independent witness shall mark the project number and sample identifier on the interior housing and ballast of the luminaires and have them shipped to the laboratory.

The testing performed by the laboratory shall include photometric, colorimetric, and electrical testing. Colorimetric values shall be determined from total spectral radiant flux measurements using a spectroradiometer. Photometric testing shall be according to IES recommendations and as a minimum, shall yield an isofootcandle chart, with max candela point and half candela trace indicated, an isocandela diagram, maximum plane and maximum cone plots of candela, a candlepower table (house and street side), a coefficient of utilization chart, a luminous flux distribution table, BUG rating report, and complete calculations based on specified requirements and test results. All testing shall cover the full spherical light output at a maximum of 5 degree intervals on both the vertical planes and the cones. Tests that "mirror" results from one hemisphere or quadrant to another are not acceptable.

The results for each photometric and colorimetric test performed shall be presented in a standard LM-79 report that includes the IDOT contract number, sample identifier, and the outputs listed above. The calculated results for each sample luminaire shall meet or exceed the contract specified levels in the luminaire performance table(s). The laboratory shall mark its test identification number on the interior of each sample luminaire.

Electrical testing shall be in accordance with LM-79.

The summary test report shall consist of a narrative documenting the test process, highlight any deficiencies and corrective actions, and clearly state which luminaires have met or exceeded all test requirements and may be released for delivery to the jobsite. Photographs shall also be used as applicable to document luminaire deficiencies and shall be included in the test report. The summary test report shall include the Luminaire Physical Inspection Checklist (see exhibit A), photometric and electrical test reports, and point-by-point photometric calculations performed in AGi32 sorted by luminaire type, wattage, and distribution. All test reports shall be certified by the independent test laboratory's authorized representative or the independent witness, as applicable, by a dated signature on the first page of each report. The summary test reports shall be delivered to the Engineer and the Contractor as an electronic submittal. Hard copy reports shall be delivered to the Engineer for record retention.

Added 6/6/18

Should any of the tested luminaires fail to satisfy the specifications and perform according to approved submittal information, all luminaires of that type, wattage, and distribution shall be deemed unacceptable and shall be replaced by alternate equipment meeting the specifications. The submittal and testing process shall then be repeated in its entirety. The Contractor may request in writing that unacceptable luminaires be corrected in lieu of replacement. The request shall identify the corrections to be made and upon approval of the request, the Contractor shall apply the corrections to the entire lot of unacceptable luminaires. Once the corrections are completed, the testing process shall be repeated, including selection of a new set of sample luminaires. The number of luminaires to be tested shall be the same quantity as originally tested.

The process of retesting corrected or replacement luminaires shall be repeated until luminaires for each type, wattage, and distribution are approved for the project. Corrections and re-testing shall not be grounds for additional compensation or extension of time. No luminaires shall be shipped from the manufacturer to the jobsite until all luminaire testing is completed and approved in writing.

Submittal information shall include a statement of intent to provide the testing as well as a request for approval of the chosen independent witness laboratory. All summary test reports, written reports, and the qualifications of the independent witness and laboratory shall be submitted for approval to the Bureau of Design and Environment in Springfield.

**Construction:** Examine all luminaires delivered to the jobsite prior to installation to ensure all specification requirements and Shop Drawing comments have been incorporated by the Manufacturer. Deficient luminaires shall not be installed and the Engineer shall be notified immediately.

Luminaires shall be adjusted with the use of a level placed along the fixture housing or other means approved by the manufacturer to make sure they are installed with their optics set to deliver optimum designed light levels on the roadway. Any dirt or film on LEDs and/or the optical assembly shall be thoroughly removed using cleaning methods approved by the manufacturer.

**Basis of Payment:** This work will be paid for at the contract unit price per Each for Luminaire, LED, Horizontal Mount, of the wattage specified which shall be payment in full for all labor, equipment and material necessary to perform the work specified herein.

Added 6/6/18



### **ELECTRIC CABLE IN CONDUIT, EQUIPMENT GROUNDING CONDUCTOR, NO. 6 1C**

This work shall be in accordance with the applicable Articles of Sections 801, 806, 873, 1076, and 1088 of the Standard Specifications with the following modifications:

This work shall consist of furnishing and installing a grounding wire to bond all traffic signal handholes (lids and rings), mast arm assemblies, posts, light poles, cabinets and exposed metallic conduits.

The Contractor shall attach the proposed ground wire to the proposed traffic structures to ground and safety bond them in accordance with NEC requirements. All labor, materials, and equipment required to bond the proposed structures (wire, clamps, hardware, etc.) shall be included in the bid price for this pay item.

The Contractor shall also be responsible for locating all handholes and uncovering them as required to facilitate the work.

The proposed ground wire shall be an insulated #6 XLP copper conductor with green insulation.

Basis of Payment: This work will be paid for at the contract unit price per foot for ELECTRIC CABLE IN CONDUIT, EQUIPMENT GROUNDING CONDUCTOR, NO. 6 1C which price shall be payment in full for all labor, materials, and equipment required to provide the grounding cable described above.

### **DETECTOR LOOP, SPECIAL**

The Contractor shall install eight 6'x6' detector loops and detector loop lead-in cable in the locations shown on the plan sheets.

This work shall be in accordance with Sections 886 and 1079 of the Standard Specifications except as modified herein.

#### **1.0 GENERAL**

This specification sets forth the procurement, installation, and performance requirements for the detection-control system (D-CS) for traffic signals. This system is intended for isolated, full-actuated intersections on high-speed roadways. Its objective is to improve the safety and operation of these intersections.

Added 6/6/18

## 2.0 VEHICLE DETECTION SYSTEM COMPONENTS

2.1 Installation and Testing of D-CS Loop Detectors: There shall be two loops per travel lane. The spacing of the loops shall be 20 ft. trailing edge to trailing edge and the loops shall be centered in each through lane. The trailing edge of the trailing loop shall be at a distance from the stop line specified on the plan sheets.

2.1.1 Inductive Loop Layout: Each detector loop shall be 6.0 ft. by 6.0 ft. square with 8.5 ft. between each pair of diagonally opposite corners. When cutting the pavement, the contractor shall not deviate more than 0.5 inch from the chalk line on leading edges of loops and no more than 1.0 inch on all other sides of the square loops. The Contractor shall round all corners to a minimum 1.0-inch radius for the full depth of the cuts. All sharp edges at corners and elsewhere shall be removed. The contractor shall not create excessive "gaps" at loop corners. All saw cuts shall be filled with loop sealant flush with the pavement surface.

2.1.2 Inductive Loop Saw Cuts: The saw cut depth shall allow for six (6) turns of loop wire to be placed such that each turn in the leading edge of each loop is "stacked" on the previous turn. Each successive wire turn shall touch the one installed below it (or before it) and the wire turns shall remain contiguous following the application of the loop sealant. Backer rod is not required. The Contractor shall install all turns in a clockwise direction and mark the beginning end on each loop.

The loop saw cuts shall be vertical and shall be at least wider than the diameter of the loop wire, up to a maximum of 0.375 inch. The top wire may be as much as 1.5 inches below the surface, but not less than 1.0 inch below the surface. The saw cut depth shall be a minimum of 2.5 inches and a maximum of 3.0 inches measured at any point along the loop perimeter. The width of home-run saw cuts shall be at least 0.25 inch wider than twice the diameter of the loop wire, up to a maximum of 0.5 inch. The top wire in the home-run cut may be as much as 1.5 inches below the surface, but not less than 1.0 inch below the surface.

2.1.3 Wire Twists in Home-Run Cut: The Contractor shall twist loop wire leads a minimum of five (5) twists per foot from the feeder slot to the first handhole.

2.1.4 Testing Loop Wires: All loop wires will be tested at the first handhole prior to the Contractor applying loop sealant. If any failures are discovered in the loop wire conductor, the Contractor will be required to replace the loop wire at no additional expense to the Department.

Added 6/6/18

2.1.5 Loop Sealant: The Contractor shall completely encapsulate the loop conductors with sealant both in the loop proper and along the wire leads. A minimum of 1.0 inch of sealant shall be provided between the top of the conductors and the top of the saw cut. The Contractor shall fill saw cuts completely with sealant such that it is flush with the top of the saw cuts. The sealant shall be either 3-M loop sealant or TA-500.

2.2.1 Loop Lead-In Cable: Loop lead-in cables shall be long enough to extend from the first handhole to the cabinet without splicing. The Contractor shall pull the lead-in cables from the first handhole to the cabinet. The shield shall be left unconnected, insulated at the splice point, and grounded only in the control cabinet. If the lead-in cable fails testing, the Contractor shall remove the defective cable and replace it at no additional cost to the Department.

2.2.2 Cable Splices: There shall be only one (1) splice between the loop and the cabinet. The splice shall be in the first handhole to connect the loop to the lead-in cable. The Contractor shall solder the cables and seal all connections with a 3-M Scotchcast splice kit.

2.3 Installation and Testing of D-CS Loop Amplifiers: The loop amplifiers for the detection-control system shall rack-mounted. Each loop shall be assigned to a separate amplifier channel. The loop amplifiers shall be connected to the traffic signal controller in accordance with the manufacturer's recommendations. This work will be paid for separately under the pay item for INDUCTIVE LOOP DETECTOR.

Basis of Payment: This work will not be paid for separately, but shall be included in the cost of DETECTOR LOOP SPECIAL.

### **ELECTRIC CABLE IN CONDUIT, LEAD-IN, NO. 12 1 PAIR**

The Contractor shall furnish and install No. 12 lead-in cable for all advanced detector loops.

This work shall be in accordance with Sections 873 and 1076 of the Standard Specifications except as modified herein.

The contractor shall install one separate lead-in cable from each detector loop to the controller cabinet. The detector loop lead-in cable shall be No. 12 AWG twisted/shielded cable.

The design shall meet the requirement of IMSA 50-2.

Basis of Payment: This work will be paid for at the contract unit price per foot for ELECTRIC CABLE IN CONDUIT, LEAD-IN, NO. 12 1 PAIR, which price shall be payment in full for all labor, materials, and equipment required to furnish, install, and test the lead-in cable described above.

Added 6/6/18

## **SHOULDER REMOVAL AND REPLACEMENT FOR ELECTRICAL WORK**

The Contractor shall remove existing shoulder to facilitate the installation of detector loop conduit at the locations shown in the plan sheets.

This work shall be in accordance with Sections 442.08 and 1030 of the Standard Specifications except as modified herein.

The width of the removal area shall be a minimum of two feet.

The Contractor shall sawcut the shoulder at the removal limits and excavate material as required to install the detector loop conduit at a 24" depth and install the detector loop riser.

After installation of the conduit, the Contractor shall backfill the area with FA-6 using four-inch lifts and compact each lift using a hand compactor to ensure proper compaction.

The Contractor shall replace the shoulder with hot mix asphalt and the replacement shoulder shall have the same thickness as the existing shoulder. The hot mix asphalt mixture shall be approved by the Engineer prior to use.

All work shall be done to the satisfaction of the Engineer.

Method of Measurement: This work will be measured by linear foot of shoulder (24" minimum width).

Basis of Payment: This work will be paid for at the contract unit price per foot for SHOULDER REMOVAL AND REPLACEMENT FOR ELECTRICAL WORK, which price shall be payment in full for all labor, materials, and equipment required to remove and replace the existing shoulder as described above.

Added 6/6/18