SP-151146
(New)

SPECIAL PROVISIONS
FOR
TRAFFIC SIGNALIZATION

Story County
STBG-SWAP-0155(706)--SG-85

Effective Date
July 19, 2022

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

151146.01 DESCRIPTION.

A. SCOPE.

1. Sections 2525 and 4189 of the Standard Specifications, as modified by these special provisions, shall apply to this project. The installation of the traffic control signals and appurtenances shall be in conformance with the MUTCD, as adopted by the Iowa DOT per IAC 761, Chapter 130.

2. These Special Provisions cover the work described in the contract documents. It covers furnishing all labor, equipment and materials, and performing all required operations to complete the work as per contract documents and to provide a completely operational and working signal system. Unless otherwise modified by the Special Provisions, all work, including equipment, material and installation, shall be in accordance with the appropriate Iowa DOT standard and supplemental specifications. Where reference is made to the codes, standard specifications, supplemental specifications, the safety orders, the general orders, the standards, laws, and ordinances, it shall mean the version of the reference that is in effect on the bid advertising date.

3. All requirements of other specifications contained or referred to in the contract documents which conflict with the Special Provisions will be considered void.

4. The Contractor shall be responsible for ONE-CALL locates of the traffic and interconnect cables installed under this project until acceptance of the project by the City.

5. At the completion of the project, the Contractor shall provide the city with as-built drawings of the signal installation.

6. At the completion of the project, the Contractor shall mark the location of all conduits with paint and flags. The Ames Public Works Department will then utilize their GPS equipment to map the conduit, footing, and handhole locations.

7. The Contractor shall measure the distance from the bottom of mast arm mounted signal heads and signs to the roadway surface beneath the signal or sign. The measurements shall be provided to the Engineer.

8. The contractor shall submit to the Traffic Engineer a list of traffic signal items (catalog cuts acceptable) that are proposed for installation.

9. The contractor must have an IMSA Level II certified Signal Technician on site at all times when work is being performed.

10. The Contractor shall notify Ames Public Works Department in writing of any discrepancy or ambiguity as to the intent or meaning of the contract documents or Special Provision before starting to work on that area. Ames Public Works Department will supply the Contractor in writing with the intent. The decision of Ames Public Works Department shall be final and conclusive.

B. DEFINITIONS.

Terms used in this Special Provision shall have the meanings defined below:

- City means City of Ames, Iowa, or its representatives.
- APWD means City of Ames Public Works Department.
- Punch List means a list of items that need to be corrected by the Contractor on the project before the final acceptance can be made.
- Response Time means the elapsed time from when the Contractor is given a notice to take certain actions to the time the Contractor actually starts the action.

151146.02 MATERIALS AND CONSTRUCTION.

A. EQUIPMENT AND MATERIALS.

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

A PDF file of shop drawings shall be furnished for steel mast arm poles to be furnished on the Project. A PDF file of catalog cuts and manufacturer's specifications shall be furnished for all standard "off-the-shelf" items.

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

All electrical equipment shall conform to the standards of NEMA, and all material and work shall conform to the requirements of the NEC, ASTM, the ASA, and local ordinances. Miscellaneous electrical equipment and materials shall be UL approved.

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

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

Any existing traffic signal equipment designated to be removed on the project shall remain the property of the City of Ames. The Contractor shall deliver any removed equipment to the City of Ames Public Works Facility, 2207 Edison Street.

B. SCHEDULE OF UNIT PRICES.

Complete and forward to the Engineer three copies of a list of unit costs for each item listed on the Schedule of Unit Prices by the preconstruction meeting. The Schedule of Unit Prices will be provided to the Contractor. The sum of the costs for each item shall equal the total Contract Lump Sum price for the traffic signal installation(s). The unit costs will be used to prepare progress payments to the Contractor. The unit costs will also be used to establish the total cost for any Extra Work Orders related to traffic signal installation work items unless otherwise negotiated.

C. TESTING AND MAINTENANCE OF SIGNAL EQUIPMENT.

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

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

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

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

D. WARRANTIES.

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

E. HANDHOLES.

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

The body of the precast hand hole shall meet the requirements for Class 1500D concrete pipe in so far as applicable.

Cast iron ring and cover (Neenah R-5900E or approved equal) may be rated light duty for non-traffic areas (145 pounds minimum); but shall be rated heavy duty for traffic areas (320 pounds minimum) where shown on the plans. Deviations in weights shall not exceed plus or minus five percent.

The cover shall have the words TRAFFIC SIGNAL cast on the top of the cover.

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

Handholes shall be installed in a neat and workmanlike manner. When the use of forms is required they shall be set level and of sufficient thickness to prevent warping or other deflections from the specified pattern. A means shall be provided for holding conduit runs rigidly in place while the concrete is placed. All conduits shall enter the hand hole at a depth of 12 inches from the top of the hand hole. Any deviations from this requirement shall be approved by the Engineer. The ends of all conduit leading into the hand hole shall fit approximately 2 inches beyond the inside wall. A coarse aggregate drain of 1 inch clean stone or gravel conforming to the dimensions shown on the plan details shall be provided. Cast iron rings and covers for handholes shall be set flush with sidewalk and pavement. The cast iron rings and covers shall be set 1 inch below finished grade when placed in soil so as to prevent damage from snow removal equipment.

Type 2 Handholes shall be Quazite 30 inch by 48 inch “PG” Style (Stackable) Assembly Model No. PG3048BB36 or approved equal. The handhole shall have a two-piece cover rated for heavy-duty loading. The legend “Traffic Signal” shall be on both pieces of the lid and be secured by two stainless steel bolts. A minimum of four cable hooks will be installed in each handhole to support the signal cables.

An Omni Marker ball, Model 163 101.4 kHz telephone marker, manufactured by Industry Technology shall be installed in each Type 2 Handhole.

F. CONDUIT SYSTEM.

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

Conduit shown on the plans as rigid steel shall be galvanized steel meeting the requirements of ANSI Standard Specification C80.1, latest revision.

Conduit shown on the plans as PVC conduit shall meet the requirements of NEMA TC-2, Type 2, and applicable UL Standards. HDPE conduit, orange in color, with an SDR of 13.5 will be allowed to be used in place of PVC conduit. For traffic signal interconnect conduit, HDPE conduit, green in color, with an SDR of 13.5 will be allowed to be used in place of PVC conduit.

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

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

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

Conduit buried in open trenches shall be placed a minimum of 24 inches deep unless otherwise directed by the Engineer or on the plans. Open trench methods of placing conduit will be permitted except where the conduit is to be placed under existing pavement. Conduit in pavement areas shall be placed to a minimum depth of 24 inches below the finished pavement surface or as directed by the Engineer.

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

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

"Pushed" conduit shall be placed by jacking, pushing, boring, or any other means necessary to place the conduit without cutting, removing, or disturbing existing pavement. The size of a bored hole shall not exceed the outside diameter of the conduit that is to be placed. Tunneling under the pavement or water jetting will not be permitted. Pits for boring shall not be closer than 2 feet to the back of curb unless otherwise directed by the Engineer.

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

G. WIRING.

Where practical, color codes shall be followed so that the red insulated conductor connects to the red indication terminal, yellow to yellow, and green to green. Circuits shall be properly labeled at the controller by durable labels, or other appropriate methods, attached to the cables.

All vehicle and pedestrian signal cable runs shall be continuous from connections made in the handhole compartment of signal pole bases to the terminal compartment in the controller cabinet. Splicing will not be allowed in underground hand holes unless specifically called for on the plans. Cable runs for radar detection cables and emergency vehicle preemption cables shall be continuous from the unit to the control cabinet.

Power lead-in cable runs shall be continuous from the Power Company service point to the meter socket and from the meter socket to the controller cabinet.

Slack for each cable shall be provided by a 4 foot length in each hand hole and a 2 foot length in each signal pole, pedestal and controller base (measured from the hand hole compartment in the pole to the end of the cable). Coil cable slack in hand hole and place on the hooks.

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

The various types of connectors (RJ45, spade, etc.) used throughout the signal installations shall be crimped using the proper crimping tool designed specifically for the connector being used.

All connections made in the pole base shall be done using Scotchlok model No. 314 Self-Stripping Electrical Pigtail Connectors or an approved equivalent. Where it is required to splice into existing interconnect in handholes, splices shall be made using watertight connectors.

H. ELECTRICAL CABLE.

General

Electrical cable for intersection signalization shall be rated 600 volts minimum. The number of conductors and size of all electrical cable shall be as shown on the plans. All wire shall be plainly marked on the outside of the sheath with the manufacturer's name and identification of the type of the cable. Home runs for cables shall be labeled as follows:

NW comer is red	SE comer is blue
NE comer is green	SW comer is orange

Power Lead-In Cable

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

Signal Cable

Signal cable shall be 600 volt, multi-conductor copper wire. Signal cable shall meet the requirements of the IMSA Specification 19-1, latest revision there off or polyethylene insulated, polyvinyl chloride jacketed signal cable. All conductors shall be No. 14 AWG unless otherwise specified on the plans. The conductors shall be stranded and not solid.

Tracer Wire

A tracer wire shall be installed in all conduits with the exception of conduits between detector loops and hand holes. The tracer wire shall be a No. 10 AWG, single conductor, stranded copper, Type THHN, with UL approval and an orange colored jacket. The tracer wire shall be spliced in the hand holes and controller to form a continuous network. The splice shall be a soldered connection and then covered with a wire nut.

Emergency Vehicle Preemption Optical Detector Cable

The cable shall meet the requirements of IPCEA-S-6I-402/NEMA WC 5, Section 7.4 600 volt control cable 75°C, Type B. The cable shall contain three conductors, each of which shall be No. 20 AWG stranded, tinned copper with 25 mil minimum average thickness low-density polyethylene insulation. Insulation shall be color coded 1-yellow, 1-blue, 1-orange. The shield shall be aluminized polyester film with a nominal 20% overlap. A No. 20 AWG stranded, tinned, bare drain wire shall be placed between the insulated conductors and the shielded in contact with the conductive surface of the shield. The jacket shall be black PVC with a minimum rating of 600 volts and 80°C and a minimum thickness of 45mil. The jacket shall be marked as required by IPECAINEMA.

Three Pair No. 18 AWG Cable

The three Pair No. 18 AWG cable shall be Belden 9773 cable.

Coaxial Cable

The cable shall be Belden 8281 coaxial cable.

Cat5E Cable

The cable shall be Cat5E outdoor use rated cable.

I. CONCRETE BASES.

Concrete bases for poles and controllers shall be poured to form a monolithic foundation and shall conform to the dimensions shown on the plans. Excavations for these bases shall be made in a neat and workmanlike manner. The bottom of all foundations shall rest securely on firm undisturbed ground. The material for the forms shall be of sufficient thickness to prevent warping or other deflections from the specified pattern. The forms shall be set level or sloped slightly to blend with the adjacent ground level and means shall be provided for holding them rigidly in place while the concrete is being deposited. All conduits shall be installed and held rigidly in place before concrete is deposited in the forms. A ground rod (s) shall be placed at each pole and controller base as shown on the plans. Anchor bolts for the signal poles or the controller cabinet shall be set in place by means of a template constructed to space the anchor bolts in accordance with the manufacturer's requirements. The center of the

template and the center of the concrete base shall coincide unless the Engineer shall direct otherwise. Concrete shall be consolidated by vibration during placement.

The top of the base shall be finished level and the top edges shall be rounded with an edger having a radius of 1/2 inch. In sidewalk areas, adjacent to sidewalks, or in other paved areas, the top 10 inches of the base shall be formed square and shall be flush with the surrounding paved area. Preformed expansion material shall be provided between the base and the other paved area. When installed in an earth shoulder away from the pavement edge, the top of the concrete base shall be approximately 2 inches above the surface of the ground. The exposed surface of the base shall have a rubbed surface finish.

After the foundation or base has been poured, absolutely no modification of any sort may be made. If the anchor bolts, conduit, or any part of the foundation or base is installed in an incorrect manner as determined by the Engineer, the entire foundation or base shall be removed and a new foundation or base installed at the Contractor's expense.

Prior to setting poles, the anchor bolts shall be covered in such a manner as to protect them against damage and to protect the public from possible injury. The foundations must be given a minimum of seven days to cure before poles are erected.

Footings shall be Class C structural concrete meeting the requirements of Section 2403 of the Standard Specifications.

Reinforcing steel shall be the type and size as shown on the plans and shall conform to the requirements of Section 2404 of the Standard Specifications.

J. BONDING AND GROUNDING.

All conduit, steel poles, and pedestals shall be bonded to form a continuous system and be effectively grounded. Bonding jumpers shall be No. 6 AWG bare copper wire or equal connected to the ground rod by Cadweld connectors. Bare copper ground wires shall be connected together by an approved mechanical crimp type of connector. Split bolt connectors will not be used.

Grounding of the conduit and neutral at the service point shall be accomplished as required by the National Electric Safety Code, except bonding jumpers shall be No. 6 AWG or equal.

Ground electrodes shall be provided at each signal pole and at the controller as detailed on the plans.

A No. 6 AWG bare copper ground wire shall be installed in all PVC conduits that carry 120 volt signal cables.

K. SIGNAL APPURTENANCES.

Signal Faces

All traffic signal displays shall be installed as indicated on the plans. All overhead displays located on each mast arm shall have each red indication set at approximately the same elevation, unless otherwise directed by the Engineer. During the course of construction and until the signals are placed in operation, signal faces shall be covered or turned away from approaching traffic. When ready for operation, they shall be securely fastened in position facing toward approaching traffic and plumb.

Controller and Battery Backup Cabinets

The controller and battery backup cabinets shall be installed at the location indicated on the Plans with the back of the cabinet toward the intersection such that the signal heads can be viewed while facing the controller, unless otherwise directed by the Engineer. The controller and battery backup cabinets shall be installed on pre-placed caulking material on the concrete base. After the cabinet is installed in place the Contractor shall also place caulking material around the base of the cabinet.

Pole Erection

All poles shall be erected so as to be vertical under normal load, with mast arms oriented at 90 degrees to the curb line, unless otherwise specified. The bases shall be securely bolted to the cast-in-place concrete foundations. Leveling shall be accomplished by the use of metal shims and/or one nut or two nuts on each anchor rod or as directed by the pole manufacturer. One nut shall be turned on each anchor rod and the pole placed in position on these nuts. The top nuts shall then be turned into place loosely and the pole adjusted to the vertical position by adjusting both the upper and lower nuts.

After leveling the poles, expansive type grout shall be troweled between the pole base and the foundation for gaps of 1 inch or greater. Exposed edges of grout shall be neatly finished to present a pleasing appearance. A weep hole shall be placed in the grout. Each pole shall be grounded by installing a No. 6 AWG bare copper ground wire between the pole and the ground rod at the foundation. If the painted or galvanized surface of any equipment is damaged in shipping or installation, such equipment shall be retouched or repaired in a manner satisfactory to the Engineer.

L. REPLACING DAMAGED IMPROVEMENTS.

Improvements such as sidewalks, curbs, driveways, roadway pavement and any other improvements removed, broken, or damaged by the Contractor shall be replaced or reconstructed with the same kind of materials found on the work or with materials of equal quality. The new work shall be left in serviceable condition satisfactory to the Engineer. Whenever a part of a square or slab of existing concrete sidewalk, driveway, or pavement is broken or damaged, the entire square or slab shall be removed and the concrete reconstructed. Surface restoration, including sidewalk, driveway, and street surface replacement, and seeding or sodding, shall be completed in accordance with the current edition of "Specification Standards for Public Improvements" of the City of Ames. Surface restoration shall be considered incidental to the bid items of the project and will not be paid for separately.

M. VEHICLE DETECTION SYSTEM.

Radar:

Purpose

The purpose of this specification is to define a microwave based sensor that will detect trucks, vehicles, motorcycles and bicycles and send a signal representative of a loop type detector in a presence mode to a traffic controller device. Herein are the specification and minimum requirements for this sensor in preparation of purchasing and operating the sensor in the field. The sensor shall be easily installed with minimum effort and shall be easy to set up and program. The sensor shall operate in the field under harsh environments and shall be immune to the effects of weather, sunlight, night problems, headlight glare, and not be susceptible to in-road breakage. It shall not be necessary to mount any hardware in the roadway, or above the roadway. The sensor shall be immune to all privacy issues that other detection devices may have.

Environmental/Power Requirements

The sensor shall function in the field without any degradation of operation within the following temperature range: -40^{o}C to + 85^{o}C. The sensor plus interface board shall operate with 24DVC supplied to the interface board card and require no other power supplies. Total current shall be no more than 415mA at anytime during operation with no output active. Typical is 360mA with no output active. Operation shall be within 20 seconds from a cold start up. Full operation shall be no greater than 2 minutes and provide for full automatic recover from a power failure. The sensor unit shall be FCC approved.

Physical Description

The sensor shall weigh no more than 5.5 pounds, and be no longer than 11 inches, no wider than 8.5 inches and no higher than 7 inches.

Operation

- The sensor shall be a microwave-based motion and presence sensor used for intersection control. The sensor shall interface with a traffic control cabinet, and shall output signals when vehicles are present in user defined zones. These zones shall be able to be created on site using an X-Y coordinate system, and have its operation verified and optimized using a laptop with Internet Explorer ™ 6.0 or greater as part of the installation process or resident on the PC.
- The sensor shall allow the user to create up to eight zones and assign vehicle presence in each of these zones with up to four outputs to the control cabinet – representing phase movements. Detection zones shall be able to be created to a maximum distance of 300 feet from the sensor itself.
- The sensor shall track the presence of a vehicle in a detection zone for a predetermined time, user selectable from 0 to 960 seconds.
- The sensor shall be able to track multiple moving and stationary vehicles simultaneously.
- Each vehicle shall be tracked using its X-Y coordinates to determine the vehicle's location.
- The sensor shall update the X-Y coordinates typically 20 times per second.
- The sensor range from the front of the sensor shall be a minimum of 50 feet to a maximum of 400 feet.
- The sensor shall be able to program eight independent zones, and provide up to four independent optical isolated outputs to the controller cabinet inputs via one of three optional sensor interface boards (modules).
- The sensor shall be able to determine and display the speed of each vehicle in the detection zones.
- The sensor shall be able to provide grid tracking for the live interactive zones.
- The sensor shall be able to provide a histogram to verify setup of the zones.
- The sensor interface shall use either English (standard) or metric units at the option of the user.
- The sensor shall be able to provide user defined delay and/or extension times for each zone.
- The sensor interface shall be able to provide a graphical representation of the vehicle track as they approach the intersection.
- The sensor shall provide a diagnostic and demonstration mode for various operations.
- The sensor shall operate via an Ethernet interface with power supplied over the Ethernet connector (POE).

Mounting

- The exact mounting position of the radar is to be determined by the engineer in the field once signal poles and mast arms are installed.
- The sensor is to be mounted for head-on (front fire) detection of approaching vehicles. When mounted on a pole a maximum 30 degree offset from the traffic direction shall be allowed to provide for optimal operation.
- The sensor shall operate optimally, and shall be mounted on a pole at a height from 14 to 19 feet.
- The range of operation shall be from 50 feet to 400 feet from the front of the sensor.
- Mounting hardware shall be supplied with each sensor to allow the device to be attached to a pole with standard stainless steel strapping bands.
- A strain release connector must be installed in the signal pole where the CAT5 cable exits to connect to the radar.
- Dielectric grease is required on all CAT5 connectors.

Radar

One radar shall be ordered to install at each approach of the intersection. A spare radar per approach shall be ordered to install in the event of a failure. **The spare radars shall be bid as an alternate to the base bid for the intersection.** The spare radars shall be delivered to the City of Ames Traffic Department. The sensor shall support five selectable channels of microwave operation and operate in the FSK-4 mode.

24.075 GHz
24.100 GHz

24.125 GHz
24.150 GHz
24.175 GHz
The beam angle shall be an Azimuth of 25 degrees to 100 feet, and then 20 degrees out to 400 feet. The elevation shall be 12 degrees.

Interface Boards
One interface board shall be ordered to install at each approach of the intersection and one spare interface board per approach shall be ordered as a spare and delivered to the City of Ames Traffic Department. **The spare interface boards shall be bid as an alternate to the base bid for the intersection equipment.** Interface boards shall be optionally available for the sensor and shall be compatible with NEMA, 170, 179 and 2070 cabinets. For each sensor one interface board shall be required and supplied as required by the user. The Interface board shall communicate with the controller cabinet. The interface board shall meet the requirements of CALTRANS 170/2070 222 and 224 modules with respect to size and form. **There shall be three optional Interface boards available with the following functions:**

- There shall be a two output Interface board that fits in a single input file slot.
- There shall be a four output Interface board that fits in a double input file slot.
- There shall be a four output Interface board that fits in a single input file slot.

Interface Board – Operation

- The interface board shall operate at 24VDC and provide the power supply for the sensor over the Ethernet cable.
- The Interface board shall have up to four LEDs to indicate the activity of each zone. (Only two LEDs are active on the two channel board).
- Each output shall be optically isolated with a LED status indicator.
- There shall be an indication for a fault mode (no Ethernet connection) such that all LEDs and Opto-isolators are on. This action shall place calls on the traffic controller.
- There shall be an RS-232 port for diagnostics on each Interface board.
- The Interface board shall provide power and short circuit protection for the sensor.
- The Interface board shall automatically recover from a power failure and start up within 20 seconds of a cold start.
- The Interface board shall be hot swappable and shall be able to be plugged in and out of the input file slot without adversely effecting its operation. (Unplugging of the Interface board shall take power off the Interface board and off the sensor.)

Single Camera Video Detection System:

1. Technical Requirements

SCVDS Detection Camera

i. The camera shall be capable of viewing all four approaches of an intersection.
ii. The camera shall utilize a single Ethernet cable for power and video
iii. The camera shall not require focusing nor aiming.
iv. The camera shall produce a useable video image under all roadway lighting conditions, regardless of time of day.
v. The field of view shall be horizon to horizon, 180 degrees using a fisheye lens.
vi. The camera shall be housed in a heated weather-tight enclosure.
vii. The output power of the heater shall vary with temperature, to assure proper operation of the lens at low temperatures and prevent moisture condensation on the optical dome of the enclosure.
viii. When mounted outdoors in the enclosure, the camera shall operate satisfactorily in a temperature range from -29°F to +165°F and a humidity range from 0% RH to 95% RH.
ix. The camera shall be powered over Ethernet connections.

x. Power consumption shall be 5 watts typical and 50 watts or less under worst conditions.
xi. All mounting hardware shall be included with a camera.

SCVDS Software

xii. The detection system shall be managed via a client application running on a City provided Microsoft Windows based computer.
xiii. The software shall facilitate placement of detection zones and setting of zone parameters or to configure system parameters.
xiv. All programming function shall occur on live video images, no snapshots or still images are allowed.
xv. The system shall default to a safe condition, such as constant call on each active detection channel, in the event of unacceptable interference, low visibility or loss of video signal.
xvi. The system shall automatically revert to normal detection mode when the problem condition no longer exists.
xvii. When a vehicle is detected within a detection zone, a visual indication of the detection shall activate on the video overlay display to confirm the detection of the vehicle for the zone.
xviii. The zone shall have the capability to calculate and store average speed and lane occupancy at user-selectable bin intervals of 5 minutes, 15 minutes, 30 minutes and 60 minutes.
xix. The system shall have the ability to show controller phase status (green, yellow or red) for up to eight phases.

SCVDS Central Control Unit (CCU)

xx. The CCU shall be supplied in a standard One Rack Unit (1U) 19 inch rack format with options for shelf mounting.
xxi. The CCU shall be powered for an 110V, 60Hz supply. CCU power consumption shall not exceed 85 Watts.
xxii. The VDS shall operate satisfactorily in a temperature range from -29°F to +165°F and a humidity range from 0% RH to 95% RH, non-condensing as set forth in NEMA specifications.
xxiii. The CCU shall utilize non-volatile memory technology to store on-board firmware and operational data.
xxiv. An Ethernet communications interface shall allow the user to remotely configure the system and to extract stored vehicle/roadway information.
xxv. The CCU shall provide an SDLC connection to the controller with an option of TS2 type 1 outputs to the controller.
xxvi. The CCU shall provide status LED indicators including unit power and vehicle calls.

Warranty

xxvii. The supplier shall provide a 5 year warranty from the date of purchase on the single camera video detection system components included in the specification.
xxviii. During the warranty period, technical support shall be available from the supplier via telephone within 4 hours of the time a call is made by a user and this support shall be available from factory-certified personnel or factory-certified installers.
xxix. During the warranty period, updates to software and firmware shall be available from the supplier without charge.
xxx. Supplier shall be responsible for all repairs, including parts, labor and shipping during this warranty period.
xxxi. One copy of the warranty shall be furnished with the bid.

Maintenance and Support

xxxii. The supplier shall maintain an adequate inventory of parts to support maintenance and repair of the single camera video detection system.
   1. These parts shall be available for delivery within 30 days of placement of an order.
   2. The supplier shall maintain an ongoing program of technical support for the single camera video detection system,
   3. The technical support shall be available via telephone or via personnel sent to the installation site upon placement of an order.
   4. All product documentation shall be written in the English language

N. ACTUATED CONTROLLER.

The Contractor shall coordinate with General Traffic Controls for procurement and installation of the traffic signal controller. The Contractor shall replace the existing traffic signal controller with updated equipment from General Traffic Controls.

The controller assembly must be a fully functional McCain ATC eX Controller. The controller assembly must fully support NTCIP 1201 and 1202 standards. The eX shall be able to communicate with McCain Transparity ATMS and McCain Adaptive. The controller must provide the interface for NEMA TS 2 Type 2 with A, B, C, and D connectors.

O. CONTROLLER CABINET AND AUXILIARY EQUIPMENT.

Existing cabinet to be used. Contractor to replace necessary auxiliary equipment to provide a complete and operational traffic signal system. The Contractor shall coordinate with General Traffic Controls for procurement and installation of the Malfunction Management Unit (MMU). The Contractor shall replace the existing MMU with updated equipment from General Traffic Controls.

An MMU-16LEip SmartMonitor Solid State conflict monitor manufactured by Eberle Design Inc. shall be provided and located within the cabinet external to and electrically independent of the controller unit and enclosed in a finished metal case. The monitor shall detect the occurrence of conflicting Green, Yellow, or Walk indications and shall cause the signals to go into predetermined flashing operation with stop timing applied simultaneously should conflicts be sensed. The monitor shall properly monitor the signal when using FYA (flashing yellow arrows) in protected left turn phases. The conflict monitor shall conform to the specifications of NEMA TS1 1983 and shall be compatible with the controller. The conflict monitor shall be equipped with the necessary cable to interface with the signal controller.

The conflict monitor shall utilize liquid crystal displays providing four indicators which display an active Red, Yellow, Green, and Walk input for each channel monitored.

Stop timing shall remain present during this operation. If the actual conflict has been cleared a reset switch (front mounted) on the conflict monitor shall return the controller to normal operation when depressed.

P. VEHICLE TRAFFIC SIGNAL HEADS.

This section of the specifications describes the minimum acceptable design and operating requirements for vehicular signal heads with 12 inch diameter lens openings, including all fittings and brackets as shown on the plans. All components of the vehicular signal heads furnished under this specification shall comply with the latest version of the Institute of Transportation Engineers Standard(s) for Adjustable Face Vehicle Traffic Control Signal Heads. All the indications of the vehicle signals will use LED modules.

LED Modules

The low power LED vehicle signals shall be installed in traffic signal housings rated as a 12 inch signal housing commercially manufactured with a durable polycarbonate material and be compatible with traffic signal mounting brackets utilizing serrated locking between signal sections. The LED signal section shall be a self-enclosed, sealed unit, with electrical connections to be terminated on the standard terminal block, spade termination, mounted in the traffic signal section. The signals shall be 120 VAC rated and shall be compatible with either public utility or backup power sources of a 60-hertz, +/-5-hertz with a voltage variance between 80 and 135.

All electronics in the signal shall meet NEMA temperature rating of -40°C to +74°C. The enclosure shall conform to NEMA Moisture Resistance Standard 250-1991 for Type 4 enclosures (ITE 6.4.6.2 Moisture Resistance). The signal electronics shall meet FCC Title 47, Subpart B, and Section 15 Regulations for Electrical Noise dissemination. The electronics shall be provided with an operating power factor correction of a minimum of 0.9 and shall be provided with fuse and transient suppression incorporated for line and load protection.

The traditional "ball" signal display shall have the following characteristics:

- Red Signal Display (Dialight 433-1210-003XL15)
- Luminous Intensity No. (cd) 365
- Dominant Wavelength (nm) 625
- Lens Tint Tinted
- Typical Wattage at 25°C 7W
- Meet or exceed current ITE specification.

- Yellow Signal Display (Dialight 433-3230-901XL15)
- Luminous Intensity No. (cd) 910
- Dominant Wavelength (nm) 590
- Lens Tint Tinted
- Typical Wattage at 25°C 9W
- Approved by Caltrans

- Green Signal Display (Dialight 433-2220-001XL15)
- Luminous Intensity No. (cd) 475
- Dominant Wavelength (nm) 500
- Lens Tint Tinted
- Typical Wattage at 25°C 7W
- Meet or exceed current ITE specification

The traditional "arrow" signal display shall have the following characteristics:

- Green Arrow Display (Dialight 432-2324-001XOD15)
- Dominant Wavelength (nm) 500
- Lens Tint Tinted
- Typical Wattage at 25°C 7W

- Yellow Arrow Display (Dialight 431-3334-901XOD15)
- Dominant Wavelength (nm) 590
- Lens Tint Tinted
- Typical Wattage at 25°C 11W

- Red Arrow Display (Dialight 432-1314-001XOD15)
- Dominant Wavelength (nm) 625
- Lens Tint Tinted
- Typical Wattage at 25°C 7W

Arrow signals shall have power factor correction and temperature compensation.

The LED modules shall be rated for low power consumption and for use in a backup power installation. LED modules shall be compatible with NEMA TS-2 requirements for traffic controller installations and be fully compliant and compatible with industry standard conflict monitors and malfunction monitor units. LED modules shall be at the rated power consumption, without exception, as backup power sources have been rated based on these design parameters. Charging circuit design shall preclude battery damage caused by continuous battery charge power availability.

LED modules shall be warranted for a minimum field life of 36 months, repair, or replacement; and, be designed for a minimum life of 7 years no degrading for illumination output caused by lens deterioration or LED degrading.

Signal Head Assembly
The housing for the individual signal sections shall be made of a durable polycarbonate. It shall be clean, smooth, and free from flaws, cracks, blowholes, and other imperfections. It shall be designed as a self-contained unit capable of separate mounting or inclusion in a signal face containing two or more signal sections rigidly and securely fastened together. It shall be equipped with openings and positive locking devices in the top and bottom so that it may be rotated between waterproof supporting brackets capable of being directed and secured at any angle in the horizontal plane. Doors and lenses shall be provided with suitable watertight gaskets and doors shall be suitably hinged and held securely to the body of the housing by simple locking devices of non-corrosive material.

The optical system shall be so designed as to prevent any objectionable reflection of sunrays even at times of the day when the sun may shine directly into the lens.

Lenses shall be 12 inches in diameter as specified on the plans. Lenses shall be polycarbonate. Glass lenses are not acceptable.

The visors for each signal section shall be durable polycarbonate not less than 0.10 inch in thickness. It shall be designed to fit tightly against the door, and shall not permit any perceptible filtration of light between it and the housing door. Visors shall be of the tunnel-type at least 8 inches long for all 12 inch rectangular pedestrian signals, at least 9 1/2 inches long for 12 inch diameter signals, shall angle slightly downward, and shall be of the type specified on the plans.

Specialized Options
- One section of each three-section signal shall be equipped with a six position terminal block for termination of field wiring. Each five-indication signal shall be equipped with an eight (8) position terminal block.
- The color of all polycarbonate signal heads, except door fronts and inside and outside of visors, shall be black. Door fronts and inside and outside of visors shall be black in their entirety. The color shall be an integral part of the materials composition.
- Signal mounting hardware for side of pole-mounted signals shall consist of a black nylon 1 way side of pole, corrosion free signal mount and appropriate fittings. Signals shall be secured to pole by using a minimum 5/8 inch wide stainless steel banding material.
- Mast arm signal head assemblies shall be rigid mounted utilizing a suitable assembly consisting of both top and bottom brackets and easily adjustable in both horizontal and vertical planes. The contractor shall use a SKYBRACKET cable clamp kit mounting hardware for mast arm mounting.
- Where shown on the plans, 5 inch back plates shall be furnished and attached to the signal faces to provide a dark background for signal indications. Backplates shall be constructed of one-piece durable black plastic capable of withstanding a 100 mph wind.

Miscellaneous Requirements
The signal heads shall be constructed of the highest quality materials. High-grade workmanship shall be used throughout. Each head shall have a smooth surface both inside and outside and shall contain no sharp fins or sharp projections of any kind.

Certification
The Contracting Authority shall be furnished with a certification from the manufacturer of the signal head that the equipment furnished under this specification complies with all provisions of this specification. If there are any items that do not comply with this specification, a list of those exceptions must be detailed on the certification.

Q. PEDESTRIAN TRAFFIC SIGNAL HEADS WITH COUNTDOWN DISPLAY.

General Requirements
This section of the specifications describes minimum acceptable design and operating requirements for a single pedestrian traffic signal head with LED "MAN" and "HAND" symbol messages The pedestrian signal head shall comply with the latest version of the Institute of Transportation Engineers Standards on Pedestrian Traffic Signal Heads.

Signal Head Assembly
Pedestrian Signal Head - 16 inches by 18 inches, Single Section, Combined Upraised Hand and Walking Person Pedestrian Signal, Countdown Timer, Side Pole Mount (EA). The combined Upraised Hand and Walking Person and Countdown Timer shall be installed in the signal head. The signal head shall be mounted using hardware that shall consist of a natural aluminum 1 way side of pole mount and appropriate fittings. Signals shall be secured to pole by using a minimum 5/8 inch wide stainless steel banding material. Backplates shall not be used on side of pole mounted signal heads. The mounting, housing, and visors for pedestrian signal heads shall conform to the provisions of "Vehicle Traffic Signal Heads" section in these specifications, and as shown on the plans.

The color of all polycarbonate signal heads, except door fronts and inside and outside of visors, shall be black. Door fronts and inside and outside of visors shall be black in their entirety. The color shall be an integral part of the materials composition.

Pedestrian Signal LED Module / Pedestrian Countdown Display LED Module

The LED modules shall fit into existing 16 inch by 18 inch traffic signal housings without modification to the housing. The module shall be Dialight 430-6479-009X

The module shall have a fuse and transient suppressor incorporated for line and load protection.

The LED signal module shall be a single, self-containing device, not requiring onsite assembly for installation into existing traffic signal housing. The assembly of the LED module shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.

The measured chromacity coordinates for the lunar white MAN and Portland orange HAND shall conform to the chromacity requirements of Section 8.04 and Figure 1 of the VTCSH standard. The chromacity measurements shall remain unchanged over the input line voltage range of 80 VAC to 135 VAC.

The LED signal module shall consist of a double message overlay combining the symbols of a filled hand and filled walking man.

The driver board shall drive the LED's at a DC current not exceeding the maximum rating recommended by the LED manufacturer. The driver board shall regulate the LED drive current on both HAND/MAN messages to compensate for the line voltage fluctuations over the range of 80 VAC to 135 VAC. The luminous output shall not vary more than 10% over the voltage range and shall not be perceptible to the human eye. The drive circuitry shall include voltage surge protection to withstand high-resolution noise transients and low-repetition high-energy transients as stated in Section 2.16 NEMA Standard TS-2, 1992. The on-board circuitry shall meet FCC Title 47.Sub-Part 8.Section 15 regulations concerning the emissions of electronic noise. The circuitry shall ensure compatibility and proper

triggering and operation of load switches and conflict monitors in signal controllers currently in use by the City.

The module shall conform to NEMA Moisture Resistance Standard 250-1991 for Type 4 enclosures (ITE 6.4.6.2 Moisture Resistance).

48 VDC LED Lens – 16 inch by 18 inch Pedestrian Signal Head with Countdown Display (EA).
This item shall consist of a 16 inch by 18 inch pedestrian LED (430-6479-009X) that combines an “Upraised Hand” and “Walking Person” on the left side, “Digital Countdown Display” on the right side of the module which shall be a single, self-contained device, not requiring on-site assembly for installation into traffic signal housing. Each module shall have multiple LED indications arranged to form an “Upraise Hand”, “Walking Person” and “Digital Countdown Display” as specified by the most current edition of the MUTCD. Each LED signal module shall be fitted with a water-tight gasket.

The LED countdown module shall be rated for use in the ambient operating temperature range of -40°F to +165°F. The module shall also be completely sealed against dust and moisture intrusion per requirements of NEMA Standard 250-1991 sections 4.7.2.1 and 4.7.3.2 for Type 4 enclosures to protect all internal components.

The measured chromacity coordinates for the Portland orange digits shall conform to the chromacity requirements of Section 8.04 and Figure 1 of the VTCSH standard. The chromacity measurements shall remain unchanged over the input line voltage range of 80 VAC to 135 VAC.

The LED signal module shall consist of two seven-segment digits. The LED's shall be distributed evenly along the message outline. The countdown digits shall be at least eight inches high and shall be made of at least 88 LED's. There shall be no electronic components visible on the front panel of the display face. The display face shall consist solely of LED's mounted on a mat black PCB.

The driver board shall drive the LED's at a DC current not exceeding the maximum rating recommended by the LED manufacturer. The drive circuitry shall include voltage surge protection to withstand high-resolution noise transients and low-repetition high-energy transients as stated in Section 2.16 NEMA Standard TS-2, 1992. The on-board circuitry shall meet FCC Title 47. Sub-Part 8.Section 15 regulations concerning the emissions of electronic noise.

The circuitry shall ensure compatibility and proper triggering and operation of load switches and conflict monitors in signal controllers currently in use by the City.

The countdown module shall be compatible with all types of traffic controllers in existence. The countdown timer module shall have a microprocessor capable of setting its own time when connected to a traffic controller. When connected, the module shall continuously monitor the traffic controller for any changes to the pedestrian phase time and re-program itself automatically if needed.

The countdown module shall register the time for the walk and clearance intervals individually and shall begin counting down from the sum of both interval times.

When the walk interval is preempted, the countdown module shall also preempt and skip directly to the clearance interval and countdown to reach 0 at the same time as the solid hand. In the cycle following the preemption call, when the module completes the walk interval countdown and the clearance interval has not yet started, the module shall display the clearance time and wait for the flashing hand to resume the countdown. When the flashing hand becomes solid, the module shall display 0 for one-second and then blank out.

The countdown module shall have an internal conflict monitor to prevent any possible conflicts between the HAND/MAN signal indications and the time display. When the HAND is solid, it shall be impossible to display any time on the display.

When the countdown module is installed in a coordinated system and the walk interval time changes at every cycle, it shall be possible to blank out the walk time and only display the clearance time.

The countdown module shall have dipswitches for the following selectable options:

- 1-display 0 during standby; 2-turn on all LED's for testing; 3-Coordinated mode, displays clearance time only; 4-disables dimming feature; 5-disables 30 second delay on dimming; 6-disables countdown display.

The module shall have a spare input for special applications such as extending or reducing time on demand.

Certification

The Contracting Authority shall be furnished with a certification from the manufacturers of the signal head, pedestrian signal LED module, and the pedestrian countdown display LED module that the equipment furnished under this specification complies with all provisions of this specification. If there are any items that do not comply with this specification, a list of those exceptions must be detailed on the certification.

Warranty

The LED signal modules shall be replaced or repaired if it fails to function as intended due to workmanship or material defects within the first 60 months from date of operation.

R. PEDESTRIAN PUSH BUTTONS.

Pedestrian Push Button Detectors shall be manufactured by Polara Engineering, Inc. The control unit shall be a Polara iCCU-S with Option A or city approved equal prior to bid. The button shall be a Polara iDS23TN0-Y-BD iDetect Accessible Pedestrian Signals ped station or city approved equal prior to bid. The push button shall be weatherproof and of sturdy design. The entire assembly shall be weather tight, secure against electrical shock, and able to withstand continuous hard usage. The button housing shall be yellow in color. Push button signs shall be furnished and shall conform to the requirements of the MUTCD. Signs shall be R10-3e, as indicated on the plans. The ped station shall be connected to signal wiring using the proper size of spade terminal unless otherwise noted in the plans. A spare ped station shall be ordered for each one required at an intersection as spares in the event of failures. The spare ped stations shall be bid as an alternate to the base bid for the intersection. The system shall be shall independent lab tested to meet:

- NEMA TS 2 Section 2.1
- Temperature & Humidity requirements, or TS4 equivalent
- Transient Voltage Protection requirements, or TS4 equivalent
- Mechanical Shock and Vibration requirements, or TS4 equivalent
- And System shall meet IEC 61000-4-4, IEC 61000-4-5 Transient Suppression requirements
- And The System shall meet FCC Title 47, Part 15, Class A Electronic Noise requirements

The Contracting Authority shall be furnished with a certification from the equipment manufacturer stating that the equipment furnished under this specification complies with all provisions of this specification. If there are any items that do not comply with this specification, then a list of those exceptions must be detailed on the certification.

S. TRAFFIC SIGNAL POLES.

General

This section of the Special Provisions described minimum acceptable design, material, and fabrication requirements for traffic signal poles. Poles shall be manufactured in accordance with the requirements of the latest Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals as approved by the American Association of State Highway and Transportation Officials. The poles shall be manufactured in accordance with City of Ames standard shop drawings. Mast arms and

pole assemblies shall be wet coat with a zinc primer painted over galvanized finish. The paint shall be standard Bronze color to match the color of current City of Ames traffic signal poles.

The traffic signal mast arm and pole assemblies shall be designed to support the number of signal heads (use weight and projected areas of die cast aluminum signal heads) and signs as shown on the plans. The mast arm and pole assemblies shall be designed to support a minimum of two signal heads and a traffic control sign at the outboard end of the arm.

The mast arms and support poles shall be continuous tapered, round, steel poles of the transformer base type as shown on the plans. The poles shall be fabricated from low carbon (maximum carbon 0.30%) steel of U.S. Standard gauge. Transformer bases will not be used when the manufacturer's structural design calculations indicate that the loadings on the pole will not permit the use of the transformer base.

When a transformer base is not used, the pole shaft shall have a handhole 10 inches by 12 inches for cable access. The handhole shall be provided with a cover.

After manufacture, they shall have minimum yield strength of 48,000 PSI. The base and flange plates shall be of structural steel conforming to AASHTO M183 (ASTM A36) and cast steel conforming to ASTM A27, Grade 65-35 or better.

It may be permissible to fabricate poles and mast arms by welding two sections together. The method used for connecting the sections shall result in a smooth joint and shall be factory welded as follows:

- All longitudinal butt welds, except within one foot of a transverse butt-welded joint, shall have a minimum 60% penetration for plates 3/8 inch and less in thickness, and a minimum of 80% penetration for plates over 3/8 inch in thickness.
- All longitudinal butt welds on poles and arms within one foot of a transverse butt welded joint shall have 100% penetration.
- All transverse butt welds for connecting sections shall have 100% penetration achieved by back-up ring or bar.
- All transverse butt welds and all specified 100% penetration longitudinal butt welds on poles and mast arms shall be examined 100% by ultrasonic inspection according to the requirements of AWS D1.1-80.AH.

Welding and fabrication shall conform to the Structural Welding Code AWS D1-180, as modified by AASHTO 1981 Standard Specifications for Welding of Structural Steel Highway Bridges and by Supplemental Specifications No. 969.

Personnel performing nondestructive testing shall be qualified in accordance with the American Society for Nondestructive Testing Recommended Practice No. SNT-TC-1A and applicable Supplements B (Magnetic Particle) and C (Ultrasonic). Evidence shall be presented for approval of the Engineer, concerning their qualifications. A report shall be required showing that welds have been inspected and either found satisfactory or found unsatisfactory but repaired and reinspected and found satisfactory. The cost offal nondestructive testing shall be paid by the Contractor and will be considered incidental to other items in the contract.

Pole manufacturers shall certify that only certified welding operators in accordance with AWS D1.1-80 were used and only electrodes as modified by AASHTO 1981 Standard Specifications for Welding of Structural Steel for Highway Bridges were used.

Mast Arm

The mast arms shall be designed to support traffic signals and/or signs as shown on the plans and indicated in these Specifications. They shall be certified by the fabricator that the mast arms are capable of withstanding winds up to 80 mph with a 1.3 gust factor without failure. The mast arms shall be of the

length as shown on the plans. The mast arms shall be galvanized inside and out in accordance with ASTM A123, latest revision.

Poles
The pole shall be designed to support the traffic signals and/or signs as shown on the plans. The pole shall be galvanized inside and out in accordance with the requirements of ASTM A123, latest revision. The pole shall be equipped with a minimum 8 inch by 12 inch hand hole and cover located in the transformer base of the pole. Securing of the cover to the base shall be done with the use of simple tools. Hardware shall be corrosion resistant.

PED Poles
Where signal plans indicate that Pedestrian Pushbuttons are located on separate poles from the signal poles, a 5 foot aluminum pole Frey Manufacturing Part No. CP6LD1CT6040TCSS shall be used with tethered base. Screw in base mounts and concrete pads may be used to attach the pedestal base to. Refer to signal plans for determining how bases are to be mounted. Pole caps must be installed on all ped poles.

Combination Pole
Where a combination street lighting/signal pole is specified on the plans, the luminaire arm is to be mounted in the same vertical plane as the signal arm unless otherwise indicated on the plans.

The luminaire arm type shall be a single member tapered type arm unless specified otherwise on the plans.

The luminaire arm shall provide the spread and nominal mounting height as shown on the plans.

Where a combination street lighting/signal pole is specified on the plans, the pole shall be equipped with a minimum 4 inch by 6 inch hand hole and cover located opposite the signal mast arm.

The luminaire arm shall be arched.

Hardware
The mast arms and poles shall be equipped with all necessary hardware, shims, and anchor bolts to provide for a complete installation without additional parts.

The anchor bolts shall meet the requirements of ASTM A36 or better.

The anchor bolts shall be hot dip galvanized for a minimum of 12 inches on the threaded end.

The anchor bolts shall be threaded a minimum of 6 inches at one end and have a 4 inch long, 90 degree bend at the other end.

The fabricator shall submit drawings for anchor bolts and base design. All hardware shall be steel, hot dipped galvanized meeting the requirements of ASTM A123, Class D or electrodeposited coated of the same coating thickness and so designed for this purpose.

Shop Drawings
All traffic signal poles shall be detailed on shop drawings by the manufacturer indicating pole and arm dimensions and attachment method along with signal weight, projected areas, and type of mounting that it is designed to accommodate.

Certifications
The fabricator shall certify that the mast arms are capable of withstanding winds up to 80 mph with a 1.3 gust factor without failure; that only certified welding operators in accordance with AWS D1.1-80 or latest revisions were used; and that only electrodes as modified by AASHTO 1981 Standard Specifications for Welding of Structural Steel for Highway Bridges were used.

T. TRAFFIC SIGNAL PEDESTALS.

This section of the specifications describes minimum acceptable design, material, and fabrication requirements for aluminum traffic signal pedestals.

Materials
The length of the pedestal, from the bottom of the base to the top of the shaft shall be as shown on the plans.

The pedestal shaft shall be fabricated of aluminum tubing with a wall thickness of not less than 0.125 inches. It shall have a satin brush or spun finish. The top of the shaft shall have an outer diameter of 4 1/2 inches and be provided with a pole cap.

The pedestal base shall be cast aluminum, square in shape, with a hand hole. The size of the hand hole shall be at least 4 inches by 6 inches and equipped with a cover which can be securely fastened to the shaft with the use of simple tools. Bases shall have a minimum weight of 20 pounds and shall have a four bolt pattern uniformly spaced on a 12-1/2 inch diameter bolt circle. The exterior of the base shall be smooth and have a neat appearance.

The base shall meet or exceed 1985 AASHTO breakaway requirements. Test reports from an FHWA approved independent laboratory shall be provided certifying tests have been accepted and approved by the FHWA as compliant to AASHTO breakaway requirements.

Anchor Bolts
4 3/4 inch by 15 inch hot rolled steel anchor bolts shall be supplied, complete with all hardware required for installation. The anchor bolts shall have a right angle bend at the bottom end and be hot dip galvanized at the threaded end.

Certification
The fabricator shall certify that the pedestals are capable of withstanding winds up to 80 mph with a 1.3 gust factor without failure.

U. TRAFFIC SIGNS.

Traffic signs shall conform to the requirements of Section 4186 of the Standard Specifications.

Traffic signs shall be mounted on the mast arms utilizing a universally adjustable SKYBRACKET cable clamp kit mounting hardware bracket.

The street name signs shall be white letters, FHWA Series B or C font, 12 inches high on a green background. The sign shall have a white border, 0.75 inches wide. The thickness of aluminum sign blanks shall be 0.125 inches and the height shall be 18 inches. The corners of the sign blank shall have a 1.5 inch radius.

The sheeting material for all signs shall be Diamond Grade Reflective Sheeting.

V. EMERGENCY VEHICLE PREEMPTION SYSTEM.

The preemption detector shall be a Strobecom II Model 4090 Series-SD as manufactured by TOMAR. The optical signal processor card shall be a Strobecom II Model 4140 as manufactured by TOMAR. A cable shall be utilized to provide data from the optical signal processor card to the RTS unit hereinbefore specified controller unit. The processor card will have four-channel detection.

The system will employ optical communication to identify the presence of designated priority vehicles and cause the traffic signal controller to advance to and/or hold a desired traffic signal display selected

from set phases normally available. The system provided shall properly receive and decode the strobe pulse, and provide a NEMA defined ground true input to the traffic signal controller. This communication is a line-of sight path of up to 2500 feet. The system requires no attention of the vehicle operator other than an "Emitter On" switch located in the vehicle that is to remain "On" until the end of the emergency run. The system shall operate on a first come first serve basis. The system shall interface with existing traffic signal controllers, without compromising normal operation or existing safety provisions. The Optical Control System shall consist of Optical emitter Assemblies, Optical Detectors and Controller Interface Assemblies, and Optical Detector Cables.

To assure desired performance, the system will provide components matched and proven through integrated testing and functional experience at several intersections. The matched component system shall offer compatibility with all types of Optical Emitters. Optical Detectors and Controller Interface Assemblies shall properly decode either a single bulb or a dual bulb emitter tuned per the above specifications. Optical Detectors and Controller interface Assemblies shall decode a band of 14.035 Hz. +/-0.050. Matched components shall provide future system compatibility offal priority control devices.

The Contractor shall work with the Communications Coordinator to have the optical signal processor card on-lined into the preemption system, verify proper programming, and address the assignment.

System Operation
The priority control sequence shall be activated by an optically transmitted signal of 14.035 Hz +/-0.05 or upon actuation of a test switch.

The system shall provide a NEMA defined ground true, steady state input to the controller.

System Component Specifications
The Optical Preemption Detector shall be a lightweight, waterproof device capable of receiving optical pulses transmitted by vehicle emitters.

The Optical Preemption Detector shall be capable of being mast arm mounted.

The Optical Preemption Detector must be responsive to the Optical Emitter at a distance of 2500 feet. The range adjustment shall be accomplished by the front panel on the Optical Signal Processor Card.

The Optical Signal Processor Card shall be equipped to receive four channels of preemption inputs.

System Equipment
The system design shall, when used in conjunction with appropriate auxiliary devices, be capable of providing basic, high priority and low priority service.

The system shall be capable of recognizing the following pulse rates as delivered by the Optical Emitter.

1. 9.63 Hz. +/-0.110 as low priority 1,
2. 14.035 Hz +/-0.05 Hz as high priority

Reliability
All equipment supplied as part of these specifications shall operate under the following environmental condition: Temperature Range: -40°C to +75°C.

The manufacturer and/or manufacturer's representative shall provide quality service before, during, and after installation of the priority control system. The manufacturer and/or manufacturer's representative must provide certified, trained technicians, traffic systems industry experience, and operational knowledge of priority control systems. Where applicable the manufacturers shall on-line the preemption location on the central computer system after installation and verify a valid communications link and programmability of the intersection.

The manufacturer shall warrant that, provided the control system has been properly installed, operated, and maintained, component parts that prove to be defective in workmanship and/or material for a minimum of one year from the date of operation for the manufacturer shall be covered in a documented system protection plan. The warranty period normally offered by the manufacturer shall apply if the offered warranty period is greater than one year.

W. COMMUNICATIONS AND NETWORK INTERFACE – when specified in project.

It is the contractor's responsibility to reconnect existing interconnect cabling to the signal controller according to the plans.

It is the contractor's responsibility to provide the following network communication equipment or approved equivalent in the controller cabinet. The equipment shall be included as part of the controller cabinet cost.

- **Actelis ML600 series switch** - ML600 Ethernet Access Devices (EADs) from Actelis Networks® enable delivery of high-speed carrier Ethernet services over existing copper and fiber network infrastructures. Available in two to eight copper pair configurations, Actelis' ML600 EADs can be deployed in a Point-to-Point configuration. The Actelis ML680 Copper Add-Drop EAD allows multiple nodes to be connected to each other over copper in a linear chain or ring configuration. Equipped with four 10/100 Base-T Ethernet interfaces plus an Ethernet COLAN (Management) port.
- **ML698 Aggregation switch** – operates in a Point-to-Multipoint topology, connecting to up four ML600 Ethernet Access Devices (EADs) delivering symmetrical Ethernet access services to over multiple voice-grade copper pairs. Each of the ML600 EADs can be connected to the ML698 via a High Speed Link (HSL) comprised of one to eight bonded copper pairs. Any combination of copper pairs per HSL can be supported to a total of eight pairs per ML698 unit. Equipped with four 10/100Base-T Ethernet interfaces plus an Ethernet COLAN (Management) port.
- **Garrettcom Magnum ES42 Edge Switch** - The Magnum ES42 Edge Switch provides six 10/100 copper switch ports to provide additional Ethernet ports.
- **Wireless router** – Routerboard RB912 wireless router or equivalent provides wireless access to each location and will interface with Actelis switches.
- **Omnidirectional antenna** – to be flush mounted on outside of cabinet.
- **NMale to NMale cable** – provides connection between wireless router and external omnidirectional antenna.
- **Cat 6 Ethernet patch cable –** provides connection between edge device and Ethernet switches.

X. BBS (BATTERY BACKUP SYSTEM).

BILL OF MATERIALS

ZincFive
Four XRT Batteries + Battery Management System (IMS) – 09000-00210-00022
Controller/Inverter – 09000-00200-00002
PIM – 09000-00200-00005

ZincFive Cabinet
XRT Cabinet - CAB457-81101-434

1 SCOPE

This specification defines the requirements of a green uninterruptible power supply (battery backup) system.

2 DEFINITIONS

A. UPS – Uninterruptible Power Supply
B. GUI – Graphical User Interface
C. NiZn - Nickel-Zinc
D. SNMP - Simple Network Management Protocol
E. SMTP - Simple Mail Transfer Protocol
F. TCP/IP - Transmission Control Protocol/Internet Protocol

3 REQUIREMENTS

A. Compatibility

The UPS shall be compatible with the agencies current traffic controller cabinet, controller and cabinet components, including the safety monitor, for full time operation. The UPS shall include all necessary cables to connect the UPS and batteries.

B. Run-time

The UPS shall be configured with batteries to provide a 2-amp cabinet load a to support a range of run time from a minimum of 4 hours to a maximum of 90 hours of operation at ambient temperature of 25°C

C. Output Capacity

UPS must provide a range of continuous active output capacity from a minimum of 1000W to 1500W, with a 90% typical inverter efficiency while running in battery backup mode. The UPS must have surge output capability of 2000W.

D. Output Voltage

When under battery power, the UPS output voltage shall be 120 VAC, ±3%, pure sine wave output, with <2% total harmonic distortion (THD), and frequency of 60 Hz ±0.5%.

E. Transfer Time

The maximum transfer time allowed, from disruption of utility line voltage to stabilized inverter line voltage from batteries shall be 33 milliseconds max. The maximum transfer time when switching from inverter line voltage to utility line voltage after the line-qualifying period shall be 33 milliseconds max. The UPS shall be capable of allowing the user to program the line qualifying period as 3, 10, or 30 seconds.

F. Operating Environment

Operating temperature for the UPS and Power Interface Module (PIM) shall be -35°F to +165°F.

G. Certifications

The UPS battery cells shall be recognized UL-2054, CSA 22.2 No. 60950-1

H. Power & Control Connections

1. Power Interface Module (PIM)

The UPS shall utilize a Power Interface Module (PIM) to connect utility AC input to the UPS and batteries as well as routing UPS output power to the cabinet load.

2. AC Connection

The AC input and output shall be separate panel mounted plug/receptacles that allow no possibility of accidental exposure to dangerous voltages.

3. Battery Connections

i. The batteries shall have digital battery bus connections to the UPS with locking connectors with provision for six battery ports. There shall be AC power

connections from the Power Interface Module to the batteries that are separate from the digital battery bus connections.

ii. The UPS must offer six battery ports that can accommodate a mix of any form-factor NiZn batteries compatible with the UPS system.

iii. The UPS must be capable of accepting batteries of different capacities at once, giving the user the ability to utilize different battery sizes to achieve required run-times.

iv. The UPS must allow the user to 'Hot Swap' any of the battery form-factors while on utility power and/or battery backup power.

I. Battery

1. The standard and extended run time (XRT) UPS batteries must utilize a Sealed Nickel-Zinc (NiZn) battery technology. Lead-Acid or Lithium battery technologies will not be accepted.

2. The standard run-time battery panel(s) must incorporate a bendable design, which allows the battery panel(s) to flex or bend for installation between the 19 inch EIA rack and the sidewall of the 33X cabinet .

3. The standard run-time module(s) must have the capability of being installed on/under a shelf or be rack mountable within the 19 inch EIA rack.

4. XRT battery solutions shall come with an intelligent management system that consolidates all battery connections to the UPS and manages the battery string.

5. The charging/battery monitoring circuitry shall be incorporated within the panel, module or extended run time battery solutions.

J. Charge

The UPS must be able to recharge standard panel and module batteries from 0% to 100% state of charge (full capacity) within 4.5 hours of complete discharge at 25°C when AC utility line voltage is available. Extended run time batteries shall be able to recharge batteries from 0% to 100% state of charge (full capacity) within 10 hours of complete discharge at 25°C when AC utility line voltage is available. The number of batteries connected to the UPS shall have NO effect on the recharge time. The batteries must be able to charge at up to 50°C ambient temperature. The UPS must not require trickle/float charging.

Wall Charging - The UPS panel, module and extended run time batteries shall be able to be charged using a 120VAC, 15A wall outlet (20A for extended run time) without need of a UPS inverter/controller, battery charger or battery tender.

K. Unit failure

The UPS must have a fail-safe utility tie feature (bypass mode) with a visual indicator that automatically cuts back to the utility line in the event of a UPS or battery failure, or complete battery discharge.

L. Operating Modes

The UPS shall have intelligent two-stage operation defined as:
Stage One: Line Attenuator, Waveform Monitoring and Switchover to Battery Backup
Stage Two: Waveform Monitoring, Return to AC Power

M. Oscilloscope Function

The UPS shall have an oscilloscope function continuously monitoring the incoming utility AC waveform. The oscilloscope function shall continuously evaluate three measures of the incoming utility AC waveform:

1. Voltage: A continuous RMS measurement with user programmable AC voltage thresholds.
2. Waveform Anomalies: Oscilloscope enhanced sensitivity mode compares incoming utility waveform to a mathematically pure sine wave reference waveform.
3. Frequency: Continuously measured with frequency deviation detected as quickly as one cycle and a default threshold of 60Hz ±6Hz.

4. Functionality and Operational Requirements

A. LCD Display

The UPS shall have a 64 by 128 Pixels LCD display with white LED backlight. From the main screen, the LCD display shall provide the following information;

1. Utility line voltage
2. UPS status
3. Cabinet consumption in watts
4. Most recent AC power outage duration
5. Battery capacity State of Charge percentage

B. LCD Display Menu

The LCD Display Menu shall provide the user the ability to program and monitor all UPS parameters;

C. Local User Interface

The UPS shall include a navigational dial to allow users the ability to navigate the menu to setup the UPS.

D. Voltage Thresholds

1. The UPS shall allow the user to set high and low AC line voltage thresholds to determine parameters to transfer from utility line power to battery backup power.
2. The UPS shall bypass utility line power if the utility line voltage is outside of the set high and low voltage parameters.
3. The UPS shall have a programmable utility AC qualification time after restoration of utility AC power to within specified voltage thresholds with choices of 3, 10 or 30 seconds.

E. Notifications

All alarm functions shall be available on SNMP, SMTP and Programmable Relay.

F. Programmable Relays

The UPS Inverter/Controller shall include eight Class 2 programmable relays, which can be triggered by power line conditions, and user selected settings of the UPS. Each relay shall have the ability to trigger by multiple conditions simultaneously. The programming options are as follows;

1. Power Fail without delay / Power fail with delay
2. Time of Day
3. Battery Capacity
4. System Fault

G. Event Log

The UPS shall provide an event log with a 1000 event capacity, which will allow the user to view the event type, date, time and duration of a given event. UPS configuration changes shall also be defined as an event and captured in the event log. The data shall be recorded in a FIFO format, so the oldest event is purged as the newest is entered.

H. Automatic Bypass Switch

The UPS shall have an automatic bypass function with a visual indicator to bypass the UPS and allow the utility line voltage through to the cabinet.

I. Circuit Breakers

The UPS system shall include a Power Interface Module (PIM) equipped with a 20A circuit breaker and automatic bypass capability.

J. Cold Start

The UPS shall be equipped with "Cold Start" capabilities, which provides the user the ability to turn the UPS on and supply battery backup power when no utility line voltage is available. This allows the user the ability to install a UPS and provide backup AC power at an intersection that has no utility line voltage available.

K. Audible Indicators

The UPS shall have audible indicators for the following parameters:

1. System Startup
2. Cold Start
3. Inverter On/Off
4. Inverter Output Over Current
5. AC Mis-wire
6. Rotating Navigation Dial with Press to Select and Back Button use
7. UPS Fault

L. Maintenance

There shall be no battery maintenance requirements for the life of the batteries including no battery rotation, maintenance discharge or cell balancing.

M. Visual Indicators

The UPS shall have visual indicators on its front panel for the following:

1. Red indicator - UPS Fault
2. Solid Green indicator - Backup Mode On
3. Flashing Green indicator - Batteries are below 10% capacity
4. Yellow - Relay Triggered

The batteries shall have the following visual indicators through a multi-color LED providing battery status and alarms

- Green = Backup Mode
- Blue = Charging Mode
- Red = Battery Fault
- White Blinking = Charged, battery at rest

5. Communication

A. The UPS must have the capability to provide Ethernet and internet protocol (IP) addressing communications with the capability for remote monitoring and programming as well as remote firmware updating capability. This capability must be provided through embedded webserver software within the UPS.

B. The UPS shall be equipped with an Ethernet port. The Ethernet port shall be an RJ45, EIA 568B pin out type connector. The Ethernet port shall be 10/100Mbps, TCP/IP capable.

6. Graphical User Interface

A. The embedded webserver will provide a Graphical User Interface (GUI) that shall be password protected and require a user ID, password and the UPS IP address to access.

B. The GUI shall have a status area that details the UPS status, location, available AC line voltage status and real-time cabinet power consumption. When in backup mode, the GUI shall display the most recent power failure duration. The status area must be displayed on every page.

C. The GUI shall have a Home screen with clickable icons and tabs, which will allow the user to navigate the GUI with ease. The home screen shall allow the user to view real-time graphical charts of the cabinet power consumption and AC line voltage status. The home screen must allow the user the ability to view a live waveform from the AC utility line in the cabinet.

D. The GUI shall have an Event Log page to allow the user to view the event type, date, time and duration of a given event. The GUI must provide the user the capability of viewing the waveform of the given event.

E. The GUI shall have a relay Configuration page to allow the user to program the relay contacts.

F. The GUI shall have a System Configuration page that allows the user to configure all the setup parameters of the UPS.

G. The GUI shall communicate notification and alerts through SNMP and SMTP protocols.

7. Warranty

The UPS, as a complete system including batteries, must be warranted to be free from defects in material and workmanship for a minimum of 5 years for the battery cells and 2 years for the electronics from the date of shipment.

151146.03 METHODS OF MEASUREMENT AND BASIS OF PAYMENT.

A. METHOD OF MEASUREMENT

Measurement for Traffic Signalization will be lump sum.

B. BASIS OF PAYMENT

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

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

The Traffic Signal Installation(s) will be paid for at the contract lump sum price bid, which price shall be full compensation for furnishing all equipment, materials, and all other work necessary or incidental to the construction of the complete signal installation and for all equipment, tools, labor, and incidentals necessary to complete the work.