SPECIAL PROVISIONS
FOR
TRAFFIC SIGNALIZATION

Linn County
IM-380-6(452)14--13-57

Effective Date
July 30, 2024

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

230202a.01 DESCRIPTION.

A. 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.

B. 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 Standard Specifications. Where reference is made to the codes, 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.

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

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

E. At the completion of the project, mark the vertical and horizontal location of all traffic signal and signal fiber optic interconnect conduits with paint and flags. Use GPS equipment to map the conduit, footing, and handhole locations. Provide a location deliverable in an electronic format that is compatible for import into the City's ArcGIS software program. Coordinate with the City prior to collecting information to assure method of data collection is compatible with City ArcGIS software program.

F. Measure the distance from the bottom of mast arm mounted signal heads and signs to the roadway surface beneath the signal or sign. Provide the measurements to the Engineer.

G. Submit to the Engineer a list of traffic signal items (catalog cuts acceptable) that are proposed for installation.

H. Notify the Engineer 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. The Engineer will supply the Contractor in writing with the intent. The decision of the Engineer shall be final and conclusive.

I. Submittals: Submit applicable brochures, technical data, catalogs, cuts, diagrams, manufacturer's drawings and installation instructions, samples if required, and other descriptive data including the complete description, trade name, model number, type, size, and rating, as well as the additional requirements listed below. All of the following must be submitted within 30 days after awarding of the contract for the project.

1. **Schedule of Unit Prices:** Submit a completed schedule of unit prices. Estimates of the work performed on the project will be made by the Jurisdiction and the unit costs will be used to prepare progress payments to the Contractor.

2. **Material and Equipment List:** Submit a completed list of materials and equipment to the Engineer for written approval before any equipment or materials are ordered.

3. **Contractor Certification:** Submit the name(s) and contact information of the International Municipal Signal Association (IMSA) Level II Certified Traffic Signal Technician(s) working on the project and a copy of their IMSA certificate.

4. **Shop Drawings:** Submit shop drawings for traffic signal poles and structures to be furnished on the project. Submit catalog cuts and manufacturer's specifications for all items in the equipment list.

J. Scheduling and Conflicts: Coordinate traffic signal installation to minimize impact to traffic. For replacement projects, existing signals shall remain operational as long as possible. This may require installation of new facilities during non-peak traffic flows, possibly at night. New mast arm installation shall not conflict or block existing active signals.

230202a.02 MATERIALS.

A. Underground.

1. **Handhole.**
   a. **Granular Base:** Comply with the following gradations; however, the Engineer may authorize a change in gradation, subject to materials available locally at the time of construction.

Sieve	Percent Passing
2"	100
1 1/2"	80 to 90
1"	15 to 20
3/4 "	0 to 0.5

   b. **Composite Handhole and Cover.**
      1) Handholes shall be Quazite Open Bottom Box (Nestible) style enclosures. They shall be Hubbell Power Systems product number PR2732BA36 or approved equal.
      2) Cover: Shall be Hubbell Power Systems product number PR2700HA0046 or approved equal. Include "TRAFFIC SIGNAL**"** text on lid.

2. **Conduit.**
   a. **General.**
      1) Furnish weatherproof fittings of identical or compatible material to the conduit. Use standard factory elbows, couplings, and other fittings.
      2) Use a manufactured conduit sealing compound that is readily workable material at temperatures as low as 30°F and will not melt or run at temperatures as high as 300°F.
   b. **Plastic Conduit and Fittings.**
      1) **PVC.**
         a) PVC Schedule 80 plastic conduit and fittings complying with NEMA TC-2 (pipe), NEMA TC-3 (fittings), and UL 651 for Schedule 80 heavy wall type. Schedule 40 fittings are allowed within concrete encasements.
         b) Solvent welded, socket type fittings, except where otherwise specified in the contract documents.
         c) Threaded adaptors for jointing plastic conduit to rigid metal ducts.
         d) Provide bell end fittings or bushings.
      2) **HDPE.**
         a) Comply with ASTM F 2160 (conduit) and ASTM D 3350 (HDPE material), SDR 13.5.
         b) Use orange colored conduit for underground fiber optic cable and red or black conduit for traffic signal cable installation.
         c) Continuous reel or straight pieces to minimize splicing.
         d) For dissimilar conduit connections, provide an adhesive compatible with both materials.
   c. **Steel Conduit and Fittings.**
      1) Steel conduit shall not be used on new construction and shall be used only as approved by the Engineer.
      2) Comply with ANSI C80.1.
      3) Use weatherproof expansion fittings with galvanized, malleable iron, fixed and expansion heads jointed by rigid steel conduit sleeves. As an option, the fixed head may be integral with the sleeve, forming a one-piece body of galvanized malleable iron.
      4) Provide steel bushings.

3. **Wiring and Cable:** Provide wire that is plainly marked on the outside of the sheath with the manufacturer's name and identification of the type of the cable.
   a. **Power Cable:** Comply with Article 4185.11 of the Standard Specifications.
   b. **Signal Cable:** Comply with IMSA Specifications 19-1 (PVC jacket) or 20-1 (polyethylene jacket) for polyethylene insulated, 600 volt, stranded, multi-conductor copper wire, No. 14 AWG. The number and size of conductors as specified in the contract documents.
   c. **Tracer Wire:** Comply with No. 10 AWG, single conductor, stranded copper, type thermoplastic heat and water resistant, nylon coated (THWN), with UL approval, and an orange-colored jacket.
   d. **Category 5E/6 (Cat5E/Cat 6) Cable:** Provide outdoor use rated cable. Cable shall be shielded with pure copper conductors. Cable shall be as per equipment Manufacturer’s recommendations.
   e. **Fiber Optic Cable and Accessories:**
      1) Furnish fiber optic cable of the mode type, size, and number of fibers specified in the contract documents, and all associated accessories.
      2) Fiber Distribution Panel: Provide a fiber distribution panel capable of terminating 48 fibers, or as specified in the contract documents. The distribution panel shall be installed within a wall or shelf mountable housing.
      3) Fiber Optic Connectors:
         a) LC type connectors of ceramic ferrule and physical contact end finish to terminate single-mode fibers to equipment.
         b) Mechanical connectors not allowed for cable splices.
         c) Maximum attenuation per connector: 0.75 dB.
      4) Fiber Optic Jumpers/Patch Cords: For connections in the cabinet, provide four factory

assembled jumpers with dielectric strength member, durable outer jacket, and LC to LC connectors. Provide two 3 foot long and two 6-foot-long fiber jumpers for connections.

5) Fiber Optic Pigtail Kits: Provide 12 single mode fiber pigtail kit with LC connectors suitable for termination of the fiber.
6) Fiber to Ethernet Switch: Shall be Comtrol RocketLinx ES9528-XT V2 fully managed layer 2 switch.

4. **Footings and Foundations.**
   a. Use Class C structural concrete complying with Section 2403 of the Standard Specifications.
   b. Use uncoated reinforcing steel complying with Section 4151 of the Standard Specifications.

5. **Bonding and Grounding.**
   a. Ground Rods: Provide 5/8 inch by 8 foot copper clad, steel ground rod.
   b. Bonding Jumper or Connecting Wire: Provide No. 6 AWG bare conductor, copper wire.

B. Detection.

1. **Video/Radar Hybrid Detection System:** Detects vehicles by processing video images and providing detection outputs to the traffic signal controller.
   a. The video/radar hybrid detection system shall be the Iteris Vantage Next with Vantage Vector Video/Radar Hybrid System.
   b. The video detection system shall be the Iteris Vantage Next Video System.
   c. The configuration will consist of four cameras (unless otherwise specified in the plans), Skybracket (or approved equal) camera mounting assemblies, shelf mount processor with SDLC link, field video monitor (minimum 9 inch screen), software and all associated equipment required to set up and operate in a field environment.
2. **Pedestrian Push Button Detectors.**
   a. **Assembly**.
      1) Ensure the entire assembly is weather tight, secure against electrical shock, withstands continuous hard usage.
      2) Provide a removable contact assembly mounted in a die cast aluminum case.
      3) Ensure contacts are normally open with no current flowing except at the moment of actuation.
      4) Ensure the contacts are entirely insulated from the housing and operating button with terminals for making connections.
   b. **Accessible Pedestrian Signals (APS) Push Buttons.**
      1) **Housing:** Die cast aluminum, weather tight, secure against electrical shock and withstands continuous hard usage.
      2) **Audible and Vibrotactile Features:** Audible walk indication tone, vibrotactile arrow, and locator tone complying with MUTCD.
      3) **Voice Messages:** As specified in the contract documents and per MUTCD.
      4) **Speaker:** Weatherproof with automatic volume adjustment to 5 dBA over ambient sound. Maximum volume 100 dB at 3 feet.
      5) **Push Button:** Nonrusting metal alloy, ADA compliant, 2 inch diameter with tactile arrow and 3 pounds maximum operational force.
      6) **Switch:** Solid state rated at 20 million operations minimum.
      7) **Program and Audio File Updates:** USB or Ethernet.
      8) **Operating Temperature:** -30°F to + 165°F.
      9) **Signs:** MUTCD signs R 10-3e (9 inches by 15 inches) on all APS units.
      10) **Braille Message:** Include on all APS pushbuttons.
      11) **Audio Files**: Provide a copy of custom audio files to the City on USB drive or CD.
      12) The APS pushbuttons, control unit, and interconnect board shall be POLARA iNavigator: Accessible Pedestrian Signals (iN2), iCCU-S, and iN2-ICB or approved equals.

C. Communications.

1. **Traffic Monitoring System:** Provide as specified in the contract documents including Pan/tilt/zoom (PTZ) Dome Camera, dome mounting bracket and hardware, camera controller, cabling from camera to controller cabinet, and all accessories and hardware necessary for a complete and operational system.
   - **a.** High definition (HD) video resolution.
   - **b.** The PTZ dome camera shall be Axis Q6315-LE with mounting hardware or equivalent.

2. **Bluetooth Travel Time Reliability System:** Detects Bluetooth signals from vehicles that are used for advanced traffic monitoring. Provide as specified in the contract documents including Bluetooth travel time reliability unit, unit mounting bracket and hardware, cabling from unit to controller cabinet, and all accessories and hardware necessary for a complete and operational system.
   - **a.** Units shall be Power over Ethernet (PoE).
   - **b.** The Bluetooth travel time reliability units shall be BlueTOAD Spectra Ethernet or approved equal.

D. Cabinets and Controller

1. **Traffic Signal Controller, Cabinet.**
   The City of Cedar Rapids will supply a shelf mount NEMA/ATC Econolite Cobalt controller with TS-2 type 2, 55 pin A connector. Contractor shall supply Econolite Cobalt communication module to allow this controller to operate in an ATC cabinet.

2. **Base Mount ATC Cabinet General Requirements:**
   - **a.** Cabinet and components shall meet current ITE ATC 5201 standards.
   - **b.** Cabinet dimensions approximately 67 inches (H) by 45 inches (W) by 26 inches (D) plus 12 inch cabinet riser
   - **c.** Cabinet shall be supplied with all necessary components for a fully operational traffic signal including network components. Cabinet shall be fully loaded with pluggable devices.

3. **Base Mount ATC Cabinet Construction:**
   - **a.** The controller and all associated equipment shall be housed in weatherproof metal cabinet of clean-cut design and appearance.
   - **b.** Cabinet, riser, and all mounting attachments shall be natural, brushed aluminum. All exterior seams shall be continuously welded.
   - **c.** Cabinet lifting eyes shall be installed on cabinet.
   - **d.** Four hinged doors shall be provided permitting complete access to the interior of cabinet. When closed, the door shall fit closely to gasket material, making the cabinet weather and dust resistant. The door shall be provided with a strong lock and No. 2 key. All doors shall have a switch to operate alarm 1.
   - **e.** Provide a stop and catch arrangement for the door. Door shall be able to be stopped at open angles of approximately 90 degrees and 180 degrees.
   - **f.** Provide a police door with a skeleton key lock. Police panel shall have signal/off switch, flash/normal switch, auto/manual control switch and pluggable manual pushbutton. Label all switches.
   - **g.** Provide a service panel on inside of cabinet door with controller on/off, flash/normal, stop time on/off/normal and flash/normal switch. Label all switches.
   - **h.** Provide an external generator inlet connection with L5-30R connector.
   - **i.** Pedestrian detection CCU shall use hardwire connection for 120 volt walk, don't walk monitoring and 24 volt pedestrian detection calls.
   - **j.** Provide a 120 volt GFCI service receptacle located in an accessible place. Outlet to be powered by a separate circuit from service pedestal, which must be a different circuit than the battery backup circuit. This outlet can be field installed.

k. Provide LED lighting controlled by a door-actuated switch to illuminate all parts of the cabinet interior during nighttime hours.

l. Provide a thermostatically controlled dual-fan unit with a minimum rating of 100 cfm to provide forced air ventilation through the cabinet. The fan unit shall be mounted to the inside top of the cabinet and shall be easily removed and replaced without having to dismantle any part of the cabinet or exhaust duct system. The thermostat controlling the fan shall be adjustable. The electrical circuit controlling the fan shall be able to be de-energized for fan replacement without affecting the signal operation. The fan shall intake air through filtered vents located near the bottom of the cabinet or cabinet door and exhaust it through a weather-proof, screened duct located near the top of the cabinet. 12 inch by 16 inch pleated cloth type filters shall be used to cover the air intakes into the cabinet. Filters shall be easily removed and replaced. Provide a 200 watt cabinet heater with thermostat.

4. Base Mount ATC Cabinet Layout.

a. Left side front, top to bottom; vehicle detection shelf, pedestrian detection shelf, print drawer/laptop table, RocketLinx ES9528-XT network switch, battery tray drawer(s)

b. Right side rear (backs up to above), top to bottom; SDLC connection panel, CyberPower PDU41001 or equivalent, input assembly terminal panel, automatic generator/utility/battery backup transfer switch, battery backup inverter, battery tray drawer(s)

c. Right side front, top to bottom; 24 channel input assembly, CMU auxiliary display unit, shelf for NEMA/ATC Cobalt controller, print drawer/laptop table, 32 channel output assembly, swing open 2RU fiber enclosure, power inlet assembly.

d. Left side rear (backs up to above), output assembly terminal panel.

5. Base Mount ATC Cabinet Connecting Cables, Wiring and Panels.

a. Provide TS-2 type 2 A connector, 55 pin for controller power

b. Provide four 2M LC-LC single mode fiber jumpers

c. Provide two 1000SFP31B20L-H SFP's and two 1000SFP49B20L-H SFP's for network switch

d. Provide network cables to connect all networkable cabinet devices to network switch, use red network cables for controller and MMU, green network cables for ped & vehicle detection devices, yellow network cable for battery backup and black network cables for all others. Provide splice trays and LC bulkheads for up to 48 fibers for use in 2RU fiber tray.

e. Provide line filter and pluggable surge suppression in power inlet assembly. Provide pluggable surge suppression at all outputs channels. Provide SDLC surge protection.

6. Base Mount ATC Cabinet Warranty: The equipment furnished shall be new, of the latest model fabricated in first-class workmanship from good quality material. The manufacturer shall replace free of charge to the purchaser any part that fails in any manner by reason of defective material or workmanship within a period of 18 months from date of shipment from the supplier's factory, but not to exceed 1 year from the date of operation after installation.

7. Base Mount ATC Cabinet Documentation: Provide two printed sets and electronic format (PDF) of the following diagrams and documentation:

a. Complete schematic diagram, accurate and current for unit supplied.

b. Complete physical description of unit.

c. Specifications and assembly procedure for any attached or associated equipment required for operation.

d. Any relevant manuals.

E. Service Cabinet and Back-To-Back Battery Back-Up System.

Provide a combination battery backup/electrical service with meter and lighting controller. The unit shall be manufactured by Tesco or approved equal.

1. **General Requirements.**
   - **a.** Provide metered disconnect for traffic signal.
   - **b.** Provide metered disconnect for street lighting.
   - **c.** Provide dedicated conduits that connect the unit with the adjacent handholes and traffic signal controller cabinet as specified in the plans.
   - **d.** The service pedestal shall be part of the continuously grounded traffic signal system.
   - **e.** Provide two 2 pole lighting circuits.

2. **Cabinet Construction.**
   - **a.** Fabrication from 1/8 inch anodized or natural brushed aluminum.
   - **b.** Small and low profile with no exposed fasteners.
   - **c.** Durable all welded construction.
   - **d.** Vandal proof doors with hasp stress rated to 2000 pounds.
   - **e.** Factory wired and tested before shipment.
   - **f.** UL approved copper cable busing and control wiring.
   - **g.** Meets EUSERC requirements.
   - **h.** Metered circuits up to 100 Amps.
   - **i.** Dual Cabinets external dimensions: 20.5 inches wide by 50 inches high by 19.25 inches deep, excluding door handles.
   - **j.** Internal parts fabricated from 14 gauge cold rolled steel.
   - **k.** Welded construction with welding materials specifically designed for the material used.
   - **l.** Stainless steel fasteners, latches, and hardware and continuous piano style hinges.
   - **m.** No exposed nuts, bolts, screws, rivets, or other fasteners on the exterior.
   - **n.** Removable back pan mounted on four welded 1/4 inch studs.
   - **o.** Fully framed side hinged outer doors with swagged close tolerance sides for flush fit with top drip lip and closed cell neoprene flange compressed gaskets. Base mounting detail identical to existing cabinets for emergency replacement.

3. **Dead front Safety Door.**
   - **a.** Hinged dead front panel with 1/4 turn latch and knurled knobs for distribution and control panel.
   - **b.** Hinged dead front door on the same side as the front door minimum opening of 120 degrees.
   - **c.** GFCI service outlet mounted in dead front panel.

4. **Power Distribution Panel.**
   - **a.** Main breakers shall be 1 pole, 2 pole, 3 pole as appropriate for the installation, and in accordance with the local utility.
   - **b.** Provide circuit breakers for the following: battery backup, signal A (after backup), signal B (after backup), 2 pole lighting A, 2 pole lighting B, service outlets, one spare breaker, and control circuit.
   - **c.** Industrial grade circuit breakers. No plug-in circuit breakers.
   - **d.** Install all branch circuit breakers in a vertical position with handle up for ‘On’, handle down for ‘Off’.
   - **e.** U.L. approved copper THHN cable busing, fully rated.

5. **Battery Back-Up System.**
   - **a.** Vandal-resistant construction.
   - **b.** 1400 VA, 950 Watts, Industry Standard run time 3 hours - all LED Intersection.
   - **c.** Typical Intersection (700 watts) run time 2 hours, with 6 to 8 hours of selected flash.
   - **d.** Inverter Tilt-out housing for easy maintenance.
   - **e.** No tools required for inverter 110 contact connections and simple slide-in installation with weight not to exceed 28 pounds.
   - **f.** Full power bypass and isolation switches.
   - **g.** Transient voltage surge protection.
   - **h.** Power analyzer with triple redundant bypass.

i. Double conversion UPS with conditioned power.
j. Power conflict monitor with isolation and transfer module.
k. Watchdog timer with redundant 5 ms delay and hard transfer to utility power.
l. Low battery and on battery relay outputs.
m. Ethernet port for local or remote monitoring.
n. Intelligent battery management system with microprocessor controlled smart battery charger, automatic self-test, and cell guard for longer life and faster recharge times.
o. 24V 18AH batteries AGM/VRLA (absorbed glass mat/valve regulated lead acid), compact, lightweight and not to exceed 25 pounds.
p. Seismically rated fixed position framed battery trays.
q. Quick swap hot battery replacement system.
r. Heavy duty smart safety battery connection system, 30A silver plated plugs.
s. Battery manufacturer's 2 year warranty.

6. Control Compartment.
a. All components to match existing components in use for maintenance of spare parts and known reliability.
b. Factory prewired cabinet.
c. All control wiring: 19 strand No. 14 AWG THHN.
d. Provide permanent terminal labels.

7. Identification Nameplates.
Identify the function of circuit breakers, switches and other components as required by laminated engraved plastic nameplates fastened with minimum of two 1/4 inch, No. 4-40 machine screws.

F. Poles, Heads, and Signs.

1. Vehicle Traffic Signal Head Assembly: Comply with current MUTCD and ITE standards.
a. General.
1) Provide signal heads complete with all fittings and brackets for a complete installation.
2) All exterior surfaces shall be black in color.
3) Traffic signal vehicle head housings and assemblies shall be EAGLE polycarbonate or approved equal.
4) Pack or crate each signal separate and complete by itself. Clearly mark the outside of each package or crate showing the manufacturer, type, catalog number, purchaser, purchase order number, and project.
b. Housing.
1) Individual signal sections made of a durable polycarbonate. Color shall be black. Color to be an integral part of the materials composition.
2) Main body assembly shall consist of one or more polycarbonate sections having integral cast serrations so when assembled with the proper brackets, may be adjusted in increments and locked securely to prevent moving. Sections shall be designed so that when assembled, they interlock with one another. Provide waterproof joints between all sections. Hold sections firmly together by locknuts or other means approved by the Engineer. Plug any open end on assembled signal face housing with an ornamental cap and gasket.
3) Equip 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.
4) Provide doors and lenses with suitable watertight gaskets and doors that are suitably hinged and held securely to the body of the housing by simple locking devices of non-corrosive material. Doors are to be easily removed and reinstalled without use of special tools.
c. Optical System: Designed to prevent any objectionable reflection of sunrays even at times of the day when the sun may shine directly into the lens.

d. Lenses: 12 inch diameter polycarbonate. Do not use glass lenses.

e. Visors.

1) Standard Installation.

a) Each signal lens is to have a visor with the bottom 25% open.

b) Minimum 0.1 inch in thickness and black in color.

c) Fits tightly against the housing door with no filtration of light between the visor and door.

d) Minimum length of 9 1/2 inches. Ensure the visor angle is slightly downward.

2) Optically Programmed Sections: When specified in the contract documents, assure the optical unit and visor are designed as a whole to eliminate the return of outside rays entering the unit from above the horizontal.

f. Terminal Block.

1) Mounted in the back of the second section of the signal head and secured at both ends.

2) Three-section signal equipped with a six-position terminal block.

3) Four- and five-section signal equipped with an eight-position terminal block.

g. Backplate.

1) Manufactured one-piece, durable, black thermoplastic capable of withstanding a 100 mph wind.

2) Thickness: 0.125 inch.

3) Rounded corners with 2 1/2 inch radii.

4) Provide minimum 5 inches of black field around the assembly.

5) Supplied with attaching bolts or screws in sufficient quantity to securely hold back plates to the signal heads.

6) Provide Pelco (or approved equal) vacuumed formed backplates compatible with EAGLE polycarbonate housings.

7) Provide backplates with all vehicle signal heads, unless otherwise directed by the Engineer.

h. Mounting Assemblies.

1) General.

a) Provide watertight assemblies.

b) Plug open segments of fittings with ornamental plugs and gaskets.

c) Banding is not allowed on upright signal poles. Drill and tap all signal heads on upright signal poles.

2) Side of Pole Mount: Provide black nylon 1 way upper and lower arm assemblies.

3) Mast Arm Mount: Provide SKYBRACKET cable mount or Astro-Brac Tallon (or approved equal) and all necessary components for a complete installation.

i. LED Modules: Comply with current ITE standards and provide LED signal modules with a 15 year warranty.

2. Pedestrian Traffic Signal Head Assembly: Comply with current MUTCD and ITE standards.

a. General: All exterior surfaces shall be black in color.

b. Housing.

1) Made of a durable polycarbonate. Color to be black and an integral part of the materials composition.

2) Provide a single unit, nominal 16 inch by 18 inch, with “egg crate” housing and mounting attachments. Left half shall display a “Hand” symbol and a “Walking person” symbol. Right half shall display clearance interval countdown numerals.

3) Equip 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.

4) Doors and lenses with suitable watertight gaskets and doors that are suitably hinged and held securely to the body of the housing by simple locking devices of non-corrosive material. Doors are to be easily removed and reinstalled without use of special tools. Lenses shall be made of vandal resistant polycarbonate or acrylic plastic.

c. Visor.
- **1)** Visor attached to the housing door by stainless steel screws.
- **2)** Fit tightly against the housing door to prevent any filtration of light between the door and the visor.
- **3)** Ensure the visor angle is slightly downward.

d. LED Module.
- **1)** Provide light emitting diode (LED) lamps with incandescent look that meet or exceed ITE PTCSI-2 LED Pedestrian Signal Specifications.
- **2)** Ensure immediate blank out of the countdown timer display upon recognizing a shortened “Walk” or a shortened "Flashing Don't Walk" interval.

e. Mounting Assemblies.
- **1) General.**
  - **a)** Provide watertight assemblies.
  - **b)** Plug open segments of fittings with ornamental plugs and gaskets.
  - **c)** Banding is not allowed on upright signal poles. Drill and tap all signal heads on upright poles.
- **2) Side of Pole Mount:** Provide black nylon one-way upper and lower arm assemblies.

3. LED Luminaire: The LED luminaires to be mounted onto the combination street lighting/signal pole assembly luminaire mast arms shall be Lumec by Signify RoadFocus RFM Cobraheads: RFM-135W-40LED-4K-G2-R2M-UNV-DMG-RCD7-PH9-GY3.

4. Traffic Signal Poles and Mast Arms.

a. General.
- **1)** Use mast arm length and vertical pole height as specified in the contract documents.
- **2)** Ensure the mast arms, poles, and supporting bases are galvanized on both interior and exterior surfaces according to ASTM A 123.
- **3)** Use ~~continuously tapered, round,~~ steel poles of the ~~transformer~~ anchor base type. Fabricate poles from low carbon (maximum carbon 0.30%) steel of U.S. standard gauge.
- **4)** ~~When a transformer base is not specified, p~~Provide a 6 inch by 16 inch handhole in the pole shaft for cable access. Provide a cover for the handhole. Secure the cover to the base with simple tools. Use corrosion resistant hardware.
- **5)** Provide a handhole directly opposite the traffic signal mast arm connection point for cable access. Provide a cover for the handhole. Secure the cover to the base with simple tools. Use corrosion resistant hardware.
- **6)** Provide a lug in the pole base near the handhole to permit connection of a No. 6 AWG grounding wire.
- **7)** Ensure minimum yield strength of 48,000 psi after manufacture. Supply base and flange plates of structural steel complying with ASTM A 36 and cast steel complying with ASTM A 27, Grade 65-35 or better.
- **8)** All flanges shall be designed with room for sockets or closed end wrenches to be used on all nuts and bolts.
- **9)** Where a combination street lighting/signal pole is specified in the contract documents the following apply:
  - **a)** Use a luminaire arm of the single member tapered type.
  - **b)** Fabricate the pole with a minimum 4 inch by 6 1/2 inch handhole and cover located opposite the signal mast arm near the bottom of the luminaire pole.
  - **c)** Luminaire extension to be a separate pole connected to the signal pole via a bolted internal tapped plate connection above the mast arm. Provide steel plates welded to the bottom of the luminaire pole and the top of the signal pole.
  - **d)** Luminaire extension pole to provide a 40 foot luminaire mounting height, unless otherwise approved by the Engineer.
  - **e)** Luminaire arm length to be 15 feet with an orientation of 10 degrees counterclockwise from the mast arm, unless otherwise noted in the contract documents.

f) Luminaire arm to be capable of supporting a pan-tilt- zoom camera. Luminaire arm shall have a 1.5 inch NPT female threaded connector on bottom of luminaire arm 5 feet from luminaire fixture mount. Threaded connector shall be designed to be plumb for level mounting of a PTZ camera.

10) Where a combination street lighting/signal pole is not specified in the contract documents, the following apply:

a) Provide a traffic signal pole that will support a future luminaire extension.

b) Provide a steel plate welded to the top of the pole to receive the future luminaire extension. Steel plate to be tapered unless otherwise specified in the contract documents.

c) Future luminaire to be installed 40 feet above the pavement surface with luminaire arm extended 15 feet from the pole, unless otherwise specified in the contract documents.

11) Provide a J- hook wire support (a curved 3/8 inch diameter steel bar) 6 inches to 12 inches above and 90 degrees with respect to the opening for each mast arm and luminaire arm.

12) Poles and mast arms may not be fabricated by shop welding two sections together.

13) Fabricate traffic signal poles and mast arms to handle the loading indicated in the contract documents.

14) Provide a rodent guard (complying with Materials I.M. 443.01 for placement between the pole base and the foundation.

b. Pole Design: Comply with AASHTO 2013 Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Use a 90 mph basic wind speed with a 50 year mean recurrence interval for strength design. Use Category II for fatigue design. Apply only natural wind gust loads (i.e. do not apply galloping loads, vortex shedding loads, or truck-induced gust loads) for fatigue design. Install vibration mitigation devices on all traffic signal pole mast arms over 60 feet in length as shown on the figures.

c. Hardware.

1) General.

a) Equip poles and mast arms with all necessary hardware and anchor bolts to provide for a complete installation without additional parts.

b) Furnish each anchor bolt with one leveling nut, one anchoring nut, and one jam nut (if required) on the exposed end and one of the following on the embedded end: nut, nut and plate, or nut and anchor bolt assembly ring plate. Use anchor bolts, nuts and washers that comply with Materials I.M. 453.08.

2) Anchor Bolts.

a) Use straight full-length galvanized bolts.

b) Comply with ASTM F 1554, Grade 105, S4 (-20 °F).

c) Threads are to comply with ANSI/ASME B1.1 for UNC thread series, Class 2A tolerance.

d) The end of each anchor bolt intended to project from the concrete is to be color coded to identify the grade.

e) Do not bend or weld anchor bolts.

3) Nuts.

a) Comply with ASTM A 563, Grade DH or ASTM A 194, Grade 2H.

b) Use heavy hex.

c) Use ANSI/ASME B1.1 for UNC thread series, Class 2B tolerance.

d) Nuts may be over-tapped according to the allowance requirements of ASTM A 563.

e) Refer to Construction section of this special provision for tightening procedure and requirements.

4) Washers: Comply with ASTM F 436 Type 1.

5) Galvanizing: Galvanize entire anchor bolt assembly consisting of anchor bolts, nuts, and washers (and plates or anchor bolt assembly ring plate, if used) according to the requirements of ASTM B 695, Class 55 Type 1 or ASTM F 2329 with zinc bath

temperature limited to 850°F. Galvanize entire assembly by the same zinc-coating process, with no mixed processes in a lot of fastener assemblies.

5. **Traffic Signal Pedestal Poles.**
   a. **Materials.**
      1) **Pedestal:** The height from the bottom of the base to the top of the shaft as specified in the contract documents.
      2) **Pedestal Shaft:** Schedule 80 with satin brush or spun finish aluminum tubing. Top of the shaft outer diameter shall be 4 1/2 inches and provided with a pole cap. Supply base collar for poles with shaft lengths greater than 10 feet. The end of the pedestal shaft shall not extend more than 1 foot above traffic signals or signs mounted on them.
      3) **Pedestal Base:** Cast aluminum, square in shape, with a handhole.
         a) **Handhole:** Minimum 6 inches by 6 inches and equipped with a cast aluminum cover that can be securely fastened to the base with the use of simple tools. Provide a lug in the base near the handhole to permit connection of a No. 6 AWG grounding wire.
         b) **Base:** Minimum weight 20 pounds with a four-bolt pattern uniformly spaced on a 12 1/2 inch diameter bolt circle. Meet or exceed AASHTO breakaway requirements.
   b. **Anchor Bolts:** Four 3/4 inch by 15 inch steel, hot dip galvanized anchor bolts complying with ASTM F 1554, Grade 36, with right angle bend at the bottom end, complete with all hardware required for installation.

6. **Pedestrian Pushbutton Station:** The pedestrian pushbutton stations shall be Frey Manufacturing CP6ACT4840TCSS Crosswalk Pedestal or approved equal.

7. **Traffic Signs.**
   a. Comply with Section 4186 of the Standard Specifications.
   b. Provide SKYBRACKET or Astro-Brac Tallon (or approved equal) for mast arm mounted signs.
   c. Comply with MUTCD and the contract documents for the street name sign dimensions, letter height and font, and sheeting.

8. **LED Blank-Out Signs.**
   a. **Materials.**
      1) **Display:** Capable of displaying symbol or word messages outlined in the contract documents; Conforms to applicable MUTCD standards; LED's designed to maintain symbol integrity if an LED fails; solid state power supply; photocell and dimming circuitry to control sign brightness and visibility.
      2) **Housing:** NEMA 3R to 4X rated/P66; 5052-H32 marine-grade aluminum, 0.125" thick; Finish-black powder coat; Includes sun visor; non-glare, high-impact, acrylic window; screened weep holes; ventilation louvers on back of housing with washable filter included; hinged door easily opens, fully sealed flanged design similar to traffic cabinets, lockable for secure access.
      3) **LEDs:** Mounted on modular circuit boards; Operating wavelengths, Red-630 nm and amber-591 nm, high intensity, AlInGaPll, White-x=0.31, y=0.31, high intensity, InGaN; Expected lifetime of 100,000 hours.
   b. **Operation.**
      1) Automatic dimming adjusts to ambient light level.
      2) Performs at temperatures ranging from -30°F to 165°F and humidity from 0 to 95% (non-condensing).
      3) Available messages include: No Right Turn Symbol (R3-1, 24 inches by 24 inches)
      4) Viewing angle: Red and white LED's: 23 degrees; amber LED's: 30 degrees
      5) Power consumption – Variable depending on message 35 W to 120 W; 120V – 60hz

G. Rectangular Rapid Flashing Beacon System.

1. General Requirements.

a. All materials furnished, assembled, fabricated, or installed shall be corrosion resistant. All mounting hardware shall be Type 304 stainless steel.

b. All components shall be manufactured and assembled as a complete system rated for 24 hours a day/7 days a week/365 days a year operation.

c. The entire system shall have a minimum 3 year warranty.

d. Each system includes, but is not limited to the following:

1) Programming software kit.
2) Wireless communication system.
3) Rectangular Rapid Flashing Beacons (RRFB) LED light bars.
4) Solar panels.
5) Accessible Pedestrian Signal (APS) push buttons with MUTCD 9 inch by 12 inch R10-25 signs.
6) Remote push button pedestal poles.
7) 13 foot pole kits with J-bolts for concrete installation.
8) Concrete footings (1 foot diameter by 3 feet deep) – for push button stations.
9) Concrete footings (2 foot diameter by 3 foot deep) – for traffic signal stations.
10) 36 inch bicycle/pedestrian signs (MUTCD W11-15; fluorescent yellow green).
11) 24 inch by 12 inch down arrow right/left signs (MUTCD W16-7P, fluorescent yellow green).
12) Sign mounting brackets.
13) Wiring, conduit, and other miscellaneous brackets and mounting hardware.

2. Rectangular Rapid Flashing Beacons.

a. Furnish and install one or two direction RRFB units mounted to a pedestal pole as indicated in the plans. The RRFB housing shall be a minimum 1/8 inch thick aluminum.

b. Each RRFB unit shall satisfy the FHWA Interim Approval for Optional Use of Rectangular Rapids Flashing Beacons (IA-21), dated March 20, 2018, and the 2009 edition of the MUTCD, including the unit size, mounting location, flash rate, and operational parameters.

3. Solar-Assisted Battery-Powered System.

a. The solar-powered system shall be an easy to install, fully self-contained, weather, corrosion, and vandal-resistant unit with premium grade UV-resistant head. The system shall be power autonomous without the need for an external power supply. The system shall have an operating temperature range of -35°F to 140°F.

b. The batteries shall be sealed, maintenance free, field-replaceable and rated best-in-class. The battery pack shall have a minimum rated lifespan of 3 years.

c. The system shall have the capacity to operate the beacons continuously for a minimum of 15 days without solar charging and have automatic light control to provide useful light during extreme conditions that prevent charging over an extended period of time.

4. Wireless Communication System.

a. At each crosswalk, all installed solar powered flashing beacon assemblies must communicate wirelessly using an unlicensed radio band so as to simultaneously commence operation of their alternating rapid flashing indications and cease operation simultaneously. The communication equipment shall comply with FCC requirements and the vendor representative shall field test the equipment prior to placing the units in operation to demonstrate the RRFBs ability to achieve property operation under the requirements of FHWA IA-21. The wireless communications of one RRFB installation shall not interfere with, or cause unintended operation of, RRFBs at nearby intersections.

b. The system shall have push-button activation. Each flashing beacon unit shall have one pedestrian push button meeting ADA requirements with the exception of an RRFB assembly in advance of the crossing.

5. **Pole and Concrete Footing.**
   - **a.** The flashing beacon assembly shall be installed and mounted as indicated in the plans, using a concrete footing meeting the requirements of pedestal pole footings. The footing shall include a 1 inch PVC conduit that stubs-out from the side of the footing as detailed per the plans. A traffic signal pedestal pole of the length recommended by the RRFB manufacturer, shall be used to support the flashing beacon assembly hardware.
   - **b.** The pedestrian push buttons shall be installed on pedestrian push button pedestal poles from Frey Manufacturing, model number CP6ACT4840TCSS. F.

6. **Pedestrian Push Buttons.**
   - **a.** The APS push buttons shall be an audible-tactile pedestrian signal system and shall consist of all electronic control equipment, mounting hardware, push buttons and signs designed to provide both a push button with a raised, vibrating tactile arrow on the button, as well as a variety of audible indications for differing pedestrian signal functions.
   - **b.** The APS push buttons shall meet the following requirements:
     - **1)** MUTCD, Chapter 4E – Pedestrian Control Features.
     - **2)** NEMA TS 2-Section 2.1 requirements for Temperature and Humidity, Transient Voltage Protection and Mechanical Shock and Vibration.
     - **3)** IEC 61000-4-4; 4-5 Transient Suppression requirements.
     - **4)** FCC Tile 47, Part 15, Class A, Electronic Noise requirements.
   - **c.** The APS push button enclosure shall meet the NEMA 250 – Type 4X enclosure requirement.
   - **d.** The APS push buttons shall be POLARA Model-iNX with MUTCD R10-25 signs or approved equals.
   - **e.** APS Functional Requirements: The APS shall have the following functional features:
     - **1)** a. The APS shall be programmable and adjustable. Programming and adjustments shall be made using a laptop computer or vendor supplied programmer. No additional hardware or equipment shall be required. The APS push buttons shall be fully compatible with the three latest versions of the Windows operating platform. The programmable features shall be:
       - **a)** Push button locator tone.
       - **b)** Audible push button informational message upon push button activation that says “yellow lights are flashing”. This message shall be spoken twice.
       - **c)** Audible crossing beacon.
       - **d)** Vibrating tactile arrow.
       - **e)** Independent minimum and maximum volume limits for the Locator Tone, Walk and Audible Beaconing features.
     - **2)** All audible features shall emanate from the pedestrian push button housing. The APS shall utilize digital audio technology, having a minimum 12 bit sample at a 16k Hz sample rate. Total harmonic distortion shall be less than 3% at 75 decibels. The APS shall provide independent ambient sound adjustment for the Locator Tone feature. The APS shall allow for Locator Tone volume to be set below the ambient noise level. The system shall have, at a minimum, three programmable locator tones. All sound levels shall adjust automatically utilizing an internally mounted, interval ambient sensing microphone in accordance with the MUTCD.
     - **3)** The APS system shall log cumulative call data. The data shall be date and time stamped and accessible via a laptop.
   - **f.** The APS manufacturer must provide the required voice messages in each button. Additionally, provide the required voice messages to the City of Cedar Rapids.
   - **g.** Provide the appropriate Braille message on the pedestrian information sign.

7. **Signage.**
   - **a.** All signs shall meet MUTCD requirements. Signs to be installed as part of the RRFB assembly and required mounting hardware shall be considered incidental to this item.
   - **b.** Sheeting for warning signs shall meet the requirements of 3M Diamond Grade DG3 fluorescent reflective yellow green sheeting.

230202a.03 CONSTRUCTION.

A. Underground.

1. Handhole.

a. Locations.

1) Do not construct in ditch bottoms, low areas where ponding of water may occur, or where they will be subject to normal vehicular traffic. Coordinate with Engineer, if necessary, to shift handhole locations in the field due to drainage topography.

2) With Engineer approval, additional handholes may be placed, at no additional cost to the Contracting Authority, to facilitate the work.

b. Excavation: Excavate as necessary to accommodate the handhole and granular base.

c. Granular Base: Install 8 inch thick granular base extending a minimum of 6 inches beyond the outside walls of the handhole.

d. Placement.

1) Do not place handholes in paved areas without Engineer's approval.

2) In paved areas, install the handhole at an elevation so the casting is level and flush with the pavement. In unpaved areas, install the handhole level, and approximately 1 inch above the final grade.

3) Verify ring placement. Invert rings when installed in paved areas.

e. Conduit.

1) Remove knockouts as necessary to facilitate conduit entrance.

2) Extend conduit into the handhole, through a knockout, approximately 2 inches beyond the inside wall. Conduit to slope down and away from the handhole.

3) Place non-shrink grout (complying with Materials I.M. 491.13) in the opening of the knockout area after placement of conduit.

f. Backfill: Place suitable backfill material according to Section 2552 of the Standard Specifications.

g. Casting: Place the casting on the handhole. Ensure the final elevation meets the handhole placement requirements.

2. Conduit.

a. General.

1) Place conduit to a minimum depth of 30 inches and a maximum depth of 60 inches below the gutter line. When conduit is placed behind the curb, place to a minimum depth of 30 inches and a maximum depth of 60 inches below top of curb.

2) Change direction at handholes or by bending, such that the conduit will not be damaged its internal diameter changed. Ensure bends are uniform in curvature and the inside radius of curvature of any bend is no less than six times the internal diameter of the conduit.

3) On the exposed ends of conduit, place bell-end fittings on PVC or HDPE conduit and bushings on steel conduit prior to installing cable. Extend all conduits a minimum of 2 inches and a maximum of 4 inches above the finished surface of any foundation, footing, or structural base.

4) When it is necessary to cut and thread steel conduit, do not allow exposed threads. Ensure conduits and fittings are free from burrs and rough places. Clean, swab, and ream conduit runs before cables are installed. Use nipples to eliminate cutting and threading where short lengths of conduit are required. Coat damaged galvanized finish on conduit with zinc rich paint. Use only galvanized steel fittings with steel conduit.

5) Pack conduit ends with a conduit sealing compound.

b. Trenched Installation.

1) Place backfill in layers not to exceed 12 inches in depth with each layer thoroughly compacted before the next layer is placed. Ensure backfill material is free of cinders, broken concrete, or other hard or abrasive materials.

2) Remove all surplus material from the public right-of-way as soon as possible.

c. Trenchless Installation.

1) When placing conduit under pavements, use the trenchless installation methods described in Section 2553 of the Standard Specifications.

2) If trenchless methods that compact soils in the bore path are used, provide sufficient cover to prevent heaving of overlying paved surfaces.

3) Do not allow pits for boring to be closer than 2 feet to the back of curb, unless otherwise specified in the contract documents.

3. Wiring and Cable.

a. Refer to the contract documents for specific color coding for each type of signal head. Ensure cables are properly labeled at the controller cabinet and in the traffic signal pole bases by durable labels, or other appropriate methods, attached to the cables.

b. Install continuous runs of vehicle and pedestrian signal cables from the vehicle or pedestrian signal head to the handhole compartment of the signal pole base. Install continuous runs of vehicle and pedestrian signal cables from the handhole compartment of the signal pole base to the terminal compartment in the controller cabinet. Do not splice signal cables in underground handholes.

c. Install continuous runs for pedestrian push button, video detection, and emergency vehicle preemption cables from the unit to the controller cabinet.

d. Install continuous runs of power lead-in cables from the service point to the meter socket and from the meter socket to the controller cabinet.

e. Install continuous detector cable from each detector loop to the first handhole adjacent to the loop. Ensure cables are properly labeled at the controller by durable labels, or other appropriate methods, attached to the cables. Install continuous homerun cable from the splice made in the first handhole to the terminal compartment in the controller cabinet. Attach the drain wire of the shielded cable to the ground in the controller cabinet.

f. Provide a minimum of 4 feet of additional cable at each handhole and loosely coil the extra cable in the handhole. Provide a minimum of 4 feet of additional cable at each signal pole (measured from the handhole compartment in the pole to the end of the cable). Provide a minimum of 10 feet of additional cable at each controller base.

g. Pull cables through conduit using a cable grip designed to provide a firm hold upon the exterior covering of the cable or cables and minimize dragging on the ground or pavement.

h. Install a tracer wire in all conduits with the exception of conduits between detector loops and handholes. Splice the tracer wire in each pole base to the ground nut, handhole to the ground rod, and in the controller cabinet to the ground rod to form a continuous run.

4. Fiber Optic Cable and Accessories.

a. Use a suitable cable feeder guide between the cable reel and the face of the conduit to protect the cable and guide the cable directly into the conduit off the reel. During the installation, carefully inspect cable jacket for defects. If defects are found, notify the Engineer prior to any additional cable being installed. Take care when pulling the cable to ensure the cable does not become kinked, crushed, twisted, snapped, etc.

b. Attach a pulling eye to the cable and use to pull the cable through the conduit. Use a pulling swivel to preclude twisting of the cable. Lubricate cable prior to entering the conduit with a lubricant recommended by the manufacturer. Use dynamometer or breakaway pulling swing to ensure the pulling tension does not exceed the specified force of 600 pounds or the cable manufacturer's recommendations, whichever is less. Do not allow the cable to twist, stretch, become crushed, or forced around sharp turns that exceed the bend radius or scar or damage the jacket. Manually assist the pulling of the cable at each pull point.

c. Do not pull cable through any intermediate junction box, handhole, pull box, pole base or any other opening in the conduit unless specified in the contract documents. Install cable by pulling from handhole or controller cabinet to the immediate next downstream handhole or cabinet. Carefully store the remaining length of cable to be installed in the next conduit run(s) in a manner that is not hazardous to pedestrian or vehicular traffic, yet ensures that no damage to the cable occurs. Storage methods are subject to Engineer approval.

d. Secure cables inside controller cabinet so that no load is applied to exposed fiber strands.
e. Ensure the radius of the bend for static storage is no less than 10 times the outside diameter of the cable, or as recommended by the manufacturer. Ensure the radius of the bend during installation is no less than 15 times the outside diameter of the cable, or as recommended by the manufacturer.
f. Provide cable slack in each handhole, junction box, and cabinet as specified in the contract documents. Provide 100 feet of slack coiled in the handhole nearest the fiber trunk line and the handhole nearest the controller cabinet. Where handholes or junction boxes lack sufficient area for cable storage or bend radius requirements, provide equivalent additional slack in adjacent facilities. Coil and bind slack cable at three points around the cable perimeter and support in its static storage position.
g. Install fiber optic accessories according to the manufacturer's recommendations and as specified in the contract documents.
h. Fiber optic cable field testing to be completed by others.

5. Footings and Foundations.
a. Placement: Prior to foundation excavation for signal poles, pedestals, and pedestrian pushbutton station posts, the locations shall be verified in the field by the Engineer.
b. Excavation: Excavate to the size, shape, and depth specified in the contract documents. Ensure the bottom of all foundations rest securely on firm undisturbed soil. Minimize over-excavation to ensure support and stability of the foundation. Construction of the foundations may require hand excavation to verify location of utilities**.**
c. Foundation: Provide a means for holding all of the following elements rigidly in place while the concrete is being placed.
1) Forms.
a) Set the forms level or sloped to meet the adjacent paved areas.
b) Provide preformed expansion material between foundation and adjacent paved areas.
c) When installed in an unpaved area, set the top of the foundation 4 inches above the surface of the ground.
d) Remove all forms before backfilling after required cure time.
2) Reinforcing Steel: Install reinforcing steel.
3) Conduit: Install conduit.
4) Anchor Bolts.
a) Set anchor bolts using a template constructed to accommodate the specified elevation, orientation, and spacing according to the pole and controller manufacturer's requirements.
b) Center the pole anchor bolts within the concrete foundation.
c) Protect the anchor bolts until poles are erected.
d) Orient controller footing 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.
5) Concrete.
a) Place concrete to form a monolithic foundation. Consolidate concrete by vibration methods.
b) Finish the top of the base level and round the top edges with an edging tool having a radius of 1/2 inch. Provide a rubbed surface finish on the exposed surface of the footing or foundation.
c) Allow the foundation to cure a minimum of 4 days prior to erecting the poles and 7 days prior to installing the mast arms. Times may be shortened if supported by strength test results.
6) Backfill: Place suitable backfill material according to Section 2552 of the Standard Specifications.

6. Bonding and Grounding.
a. Ensure the traffic signal installation is grounded as required by the NESC.

b. Install a ground rod at the handhole nearest each signal pole foundation and controller footing.
c. Bond poles, pedestals, pushbutton stations, and cabinets to ground rods with copper wire. Connect ground wires to ground rods with approved mechanical connectors.
d. Bond rigid steel conduit ends in handholes with copper wire and approved fittings.

B. Detection.

1. **Video/Radar Hybrid Detection System:** Install according to the manufacturer's recommendations and as specified in the contract documents. Coordinate with overhead utility companies to assure required clearances are provided and assure utility locations do not obstruct or interfere with the operation of the video detection.

2. **Pedestrian Push Button Detectors:**
   a. Install according to the manufacturer's recommendations.
   b. Seal the wire entrance into the pedestrian push button assembly.
   c. The placement of the pedestrian pushbuttons is critical in meeting ADA requirements. Final pushbutton placement to be approved in the field by the Engineer.

C. Traffic Monitoring System.
Install according to the manufacturer's recommendations and as specified in the contract documents, as well as the following:

1. Position camera dome on the pole as directed by the Engineer.

2. Test installed system under the supervision of the Engineer and certify as fully functional.

D. Cabinet and Controller.

1. **Controller, Cabinet, and Auxiliary Equipment.**
   a. Install according to the manufacturer's recommendations and as specified in the contract documents.
   b. Install on pre-placed caulking material on the concrete base. After the cabinet is installed in place, apply caulking material around the base of the cabinet.
   c. Mount with 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.
   d. All field wiring must be directly attached to the wiring lugs. Attachment of wiring shall be in a neat and workmanlike manner.
   e. Seal conduit openings in the controller cabinet with an approved sealing compound per materials section of this special provision.
   f. Deliver in good condition to the Engineer all wiring diagrams, service manuals, instructions for installing and maintaining the equipment.
   g. Inspection of the installation by the Engineer or their representative shall be completed prior controller activation to assure proper installation in accordance with the manufacturer's recommendations.

2. **Controller:** Install according to the manufacturer's recommendations and as specified in the contract documents.

3. **Multi- Malfunction Unit:** Install according to the manufacturer's recommendations and as specified in the contract documents.

4. **UPS Battery Backup System:** Install according to the manufacturer's recommendations and as specified in the contract documents.

5. **Emergency Vehicle Preemption System:** When specified for as part of contract documents,

install according to the manufacturer's recommendations and as specified in the contract documents.

E. Poles Heads, and Signs.

1. Vehicle and Pedestrian Traffic Signal Heads.

a. Inspect each signal head assembly while still on the ground for the following:
- **1)** Physical defects
- **2)** Visor type
- **3)** LED wattage
- **4)** Lens orientation
- **5)** Wiring connections

b. Attach signal head mounting hardware according to the manufacturer's recommendations. Apply anti-seize compound to all mechanical fasteners.

c. Adjust each signal head both vertically and horizontally to approximate a uniform grade of all like signal heads.

d. During the course of construction and until the signals are placed in operation, cover signal faces. When ready for operation, plumb and aim heads.

e. Note the date of activation on the back of each LED module in black permanent marker.

2. Traffic Signal and Pedestal Poles and Pedestrian Push Button Posts.

a. Erect all poles and posts vertically under normal load.

b. Securely bolt the bases to the cast-in-place concrete foundations using the following procedures. Perform this work only on days with winds less than 15 mph. Tighten all the nuts in the presence of the inspector. Once the tightening procedure is started, complete on all the base plate nuts without pause or delay.
- **1)** Use properly sized wrenches or sockets, or both, designed for tightening nuts or bolts, or both, to avoid rounding or other damage to the nuts. Do not use adjustable end or pipe wrenches.
- **2)** Ensure base plates, anchor rods, and nuts are free of all dirt or debris.
- **3)** Apply stick wax or bees wax to the threads and bearing surfaces of the anchor bolt, nuts, and washers.
- **4)** Tighten top nuts so they fully contact the base plate. Tighten leveling nuts to snug tight condition. Snug tight is defined as the full effort of one person on a wrench with a length equal to 14 times the bolt diameter but not less than 18 inches. Apply full effort as close to the end of the wrench as possible. Perform tightening by leaning back and using entire body weight to pull firmly on the end of the wrench until the nut stops rotating. Perform a minimum of two separate passes of tightening. Sequence tightening in each pass so that the nut on the opposite side, to the extent possible, is subsequently tightened until all the nuts in that pass have been tightened.
- **5)** Tighten top nuts to snug tight as described for leveling nuts.
- **6)** Match-mark the top nuts and base plate using paint, crayon, or other approved means to provide a reference for determining the relative rotation of the nut and base plate during tightening. Further tighten the top nuts, in two passes as listed below using a striking or hydraulic wrench. Follow a sequence of tightening in each pass so that the nut on the opposite side, to the extent possible, is subsequently tightened until all nuts in that pass have been turned. Do not allow the leveling nut to rotate during the top nut tightening.

Anchor Bolt Size	First Pass	Second Pass	Total Rotation
Less than or equal to 1 1/2-inch diameter	1/6 turn	1/6 turn	1/3 turn
Greater than 1 1/2-inch diameter	1/12 turn	1/12 turn	1/6 turn

- **7)** Lubricate the jam nuts, place, and tighten to snug tight.

c. A torque wrench should be used to verify that a torque at least equal to the computed

verification torque, Tv, according to paragraph 6.9 of FHWA *Guidelines for the Installation, Inspection, Maintenance, and Repair of Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, is required to additionally tighten the top nuts. An inability to achieve this torque should be interpreted to indicate that the threads have been stripped and should be reported to the Engineer.

d. After leveling the poles, install a rodent guard between the pole base and the foundation.

e. Apply anti-seize compound to all mechanical fasteners on pole access doors.

f. Install pedestrian push button post caps with tamper-proof set screws per manufacturer's direction or by driving the cap a minimum of 1/2 inch onto the post.

3. Traffic Signs: Install signs by drilling and tapping to the pole. Apply anti-seize compound to all mechanical fasteners.

F. Temporary Traffic Signal.

Construct according to the configuration specified in the contract documents. Refer to Section 2525 and Article 2528.03, G of the Standard Specifications for additional information. Refer to plan notes for additional information and requirements pertaining to communication needs for remote monitoring and signal timing coordination purposes.

G. Rectangular Rapid Flashing Beacon System.

1. The solar powered flashing beacon assembly and system shall be installed in strict accordance with the manufacturer's recommendations, plan set detail, and as directed by the Engineer.

2. Mounting of the hardware to the foundation shall be in accordance with contract documents and shall follow all manufacturer recommendations. The traffic signal post and pedestal base shall be installed on the foundation in accordance with the manufacturer recommendations.

3. The beacons and solar engine shall be attached to the structure using rigid galvanized steel conduit, stainless steel straps, manufacturer recommended mounting brackets, and U-bolts.

4. The beacons shall be installed as shown on the Plans. The final elevation and location of the beacons must be approved by the Engineer prior to beginning work.

5. The solar panel shall be installed at the highest point on the assembly structure, or as directed by the Engineer. The solar engine shall be installed at a 45 degree angle facing the equator (due south) with full unobstructed solar exposure for optimum performance of the system.

H. Surface Restoration.

1. Replace or reconstruct features removed as a part of the work, such as sidewalks, driveways, curbs, roadway pavement, unpaved areas, or any other items.

2. Complete restoration according to the applicable sections of the Standard Specifications or as directed by the Engineer.

I. Testing.

1. Cabinet testing: deliver cabinet to City of Cedar Rapids Traffic Signal Shop a minimum of 2 weeks prior to installation for testing.

2. Notify the Engineer 5 working days in advance of the time and date the signal or signal system will be ready for activation. Do not turn on the signal or signal system without authorization of the Engineer and the City of Cedar Rapids Traffic Engineering Division.

3. Ensure a representative from the manufacturer and/or supplier of the detection system or other authorized person is at the project site when the detection system is ready to be turned on to provide technical assistance including, as a minimum, programming of the system.

4. All required signal timing data will be provided by the City of Cedar Rapids.

5. A test period of 30 calendar days will start upon confirmation from the Engineer that the signal or signal system is operating consistent with the project requirements. Any failure or malfunction of the equipment furnished by the Contractor, occurring during the test period will be corrected by the Contractor at no additional cost to the Contracting Authority. Upon confirmation by the Engineer that any failure or malfunction has been corrected, a new test period of 30 calendar days will start, exclusive of minor malfunctions such as lamp burnouts. Repeat this procedure until the signal equipment has operated satisfactorily for 30 consecutive calendar days.

6. After signal turn on and prior to completion of the 30 calendar day test period, respond, within 24 hours, to perform maintenance or repair of any failure or malfunction reported.

7. If there are multiple traffic signals within the project, the test period shall not begin until all signals within the project are installed and ready to be tested.

J. Documentation.

1. Provide file documentation packages with each signal system, consisting of the following:
   - **a.** Complete cabinet wiring diagram.
   - **b.** Complete physical description of the equipment.
   - **c.** Controller printout or equal documentation of initial controller settings installed in the field or in the office.
   - **d.** Product manuals for all cabinet equipment.
   - **e.** Standard industry warranties on equipment supplied.
   - **f.** Documentation of field cable labeling scheme.
   - **g.** Diagram of phasing and detector locations.
   - **h.** One set of as-built construction plans indicating changes from the original contract documents.
   - **i.** Complete list of serial numbers for all devices and components supplied by the Contractor.

2. Supply all documentation in electronic form, along with two complete sets of paper documentation. One set to be placed in the controller cabinet and the other set (less construction plan) to be delivered to the Engineer.

K. Removal.

1. Notify the City Traffic Engineering Department prior to beginning removals.

2. Coordinate with Traffic Signal Division at traffic@cedar-rapids.org to determine components of cabinets to salvage and deliver them to a salvage location at the City's Traffic Signal Shop. All other signal equipment shall be removed and disposed of by the Contractor. Signal bases only need to be removed to 4 feet below final grade and to the point where a conflict with any other proposed work is eliminated. Work shall also include backfilling any resulting holes to existing grade.

230202a.04 METHOD OF MEASUREMENT.

A. Traffic Signalization.
Lump sum item; no measurement will be made.

B. Removal of Traffic Signalization.
Lump sum item; no measurement will be made.

C. Temporary Traffic Signals.
By count for each group installation of temporary traffic signals operated by a common control unit. A group installation is normally four signal heads at the same traffic conflict area.

230202a.05 BASIS OF PAYMENT.

A. Traffic Signalization.
Payment will be at the lump sum price for Traffic Signalization per this special provision, including RRFBs. Partial payment will be made according to the approved schedule of unit prices for those materials installed.

B. Removal of Traffic Signalization.
Payment will be at the lump sum price for Removal of Traffic Signalization. Lump sum price includes: removal of poles, concrete pads, foundations, wiring, traffic signal cabinet and equipment, pedestrian signal equipment, and handholes; delivery of removed materials to the location specified in the contract documents (if specified); furnishing, placing, and compacting backfill in all excavations; and restoring disturbed surfaces.

C. Temporary Traffic Signals.
Payment for each group installation is full compensation for furnishing, installing, maintaining and servicing the controller, signal heads, traffic detection system, signal operator, costs for electrical energy, and the cost of removing temporary traffic signal materials from the construction site. The Contractor shall supply their own breaker box and power meter and shall not connect to existing Contracting Authority owned circuits to supply power for temporary traffic signals.