

**SP-123002
(New)**



**SPECIAL PROVISIONS
FOR
TRAFFIC SIGNALIZATION**

**Woodbury County
STP-A-7057(676)--86-97**

**Effective Date
July 15, 2014**

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

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PART I GENERAL REQUIREMENTS

This part consists of the general provisions necessary when furnishing and installing the infrastructure as described in the project plans and these special provisions.

This project involves supplying and installing conduit, handholes, traffic signal cabinets, footings, battery backup cabinets, tracer wire, pull tape, power supplies, and fiber deemed necessary to complete a fiber optic network designed for use for traffic signal coordination and other uses planned by the City of Sioux City.

The Contractor shall not take advantage of any apparent error, discrepancy or omission in the plans or specifications. Upon discovery of such an error, discrepancy or omission, the Contractor shall notify the Engineer immediately. The Engineer will then make such corrections or interpretations as necessary to fulfill the intent of the plans and specifications.

Materials or work described in words which, so applied, have known technical or trade meaning shall be held to refer to such recognized standards.

Figured dimensions on the plans shall be taken as correct but shall be checked by the Contractor before starting construction. Any errors, omissions, or discrepancies shall be brought to the attention of the Engineer and the Engineer's decision thereon shall be final. Correction of errors or omissions on the contract documents may be made by the Engineer when such correction is necessary for the proper execution of the work.

1.01 Related Specifications and Standards

The work as detailed on the plans for the Gordon Drive Traffic Signal Coordination shall be completed in accordance with the plans, special provisions and all other contract documents including the documents listed below. A requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete project.

1. 2012 edition of the Standard Specifications of the Iowa DOT with GS-12004
2. Latest published Supplements to Standard Specifications
3. Specifications of the Underwriter's Laboratories, Inc.
4. National Electric Code
5. Manual on Uniform Traffic Control Devices
6. Iowa DOT Flagger's Handbook
7. Iowa DOT Standard Road Plans Manual

1.02 Local Requirements

Comply with any special requirements and limitations identified in the plans.

1.03 Contractor's Responsibility

A. Coordination with Utilities

1. The Contractor is responsible for determining the exact location and elevation of all public utilities in proximity to any construction work and shall conduct all activities to ensure that public utilities are not disturbed or damaged.
2. The Contractor is fully liable for all expenses incurred as a result of failing to obtain required clearances, location of utilities, and any damage to utilities caused by construction.

3. Utility companies whose facilities are shown on the plans or known to be within the construction limits shall be notified by the Contractor of the starting construction date.
4. Utility company contacts are listed in the plans. Iowa Communications Network, Iowa Network Services, Long Lines, and Woodbury County Rural Electric have indicated facilities in the area. This list of companies is not necessarily exhaustive.

B. One Call Locating

Until final acceptance, the Contractor shall provide all utility locates of the work performed under this contract when requested through One-Call services or by the Engineer. The Contractor shall perform any such locations within 24 hours of receiving notice that such locations are needed.

C. Material and Equipment Storage and Site Access

1. Contractor shall secure a designated material storage area for this project. Any request to store material in the right-of-way in order to complete the current work activity shall be approved by the Engineer.
2. Construction equipment may be stored within the right-of-way during non-working hours if it is outside of the roadway clear zone, as far from the traveled way as practical and as approved by the Engineer. No equipment shall be stored at the toe of any roadway slope.

D. Finishing Activities

Upon completion of the work at each project area, thoroughly clean the site and restore it to a condition at least equal to that existing prior to construction. Project area is defined as the approximate area disturbed during a normal week of work. During and after completion, employ appropriate measures for erosion control, where applicable. Seed and fertilize work areas upon completion of work in accordance with the contract documents. Final clean-up and finishing work is considered subsidiary.

1.04 Contractor Submissions

A. Material List

The Engineer shall furnish a list of materials required for the project to each bidder with the proposal. Complete and submit one electronic pdf file of the materials list within (14) calendar days after award of the project contract. Include the name of the materials supplier and catalog number of each item listed.

B. Construction Schedule

1. Within 30 days after award of contract, the Contractor shall submit to the Engineer one electronic pdf file of the detailed construction schedule including dates of commencement for each major work item, duration of each major work item and completion of each major work item on each segment of the proposed construction.
2. Major items of work to be included on the schedule are installation of conduit, handholes, footings, cabinets, and electrical / fiber installations.
3. Upon acceptance of the schedule, the Contractor will be expected to adhere to these dates as proposed unless modified with the approval of the Engineer.
4. Submittal and approval of the proposed construction schedule by the Engineer is required before the Contractor can commence construction activities.

C. Shop Drawings/Catalog Cuts

1. Prior to construction and after approval of the Materials List, submit one electronic pdf file of

the shop drawings or catalog cuts for the materials to the City of Sioux City for approval.

2. The Engineer shall review the shop drawings/catalog cuts for the purpose of assuring general conformance with the project design concept and contract documents.
3. Provide written notice of any deviations from the requirements of the plans or contract documents.
4. Engineer's approval of shop drawings/catalog cuts does not relieve the Contractor of responsibility for providing satisfactory materials complying with the contract documents. Errors not detected during review do not authorize the Contractor to proceed in error.
5. The Engineer shall provide approval before any materials are ordered.

D. Materials Procurement

1. Shop drawings, specification data, and samples for acceptance testing (when requested) shall be submitted to the City of Sioux City for approval and/or selection prior to the placing of orders for any equipment and materials.
2. The Contractor shall order all materials requiring production lead time greater than 4 weeks within 5 business days of receiving the approved shop drawing(s).
3. The Contractor shall submit to the Engineer proof of material purchase order in electronic pdf format.

E. Warranty

1. Transfer all required standard materials warranties on the date of final acceptance to the City of Sioux City.
2. Warranty periods shall not commence prior to final acceptance of the work.

1.05 As-Built Documentation

- A. As-built record drawings will be the responsibility of, and completed by the Contractor. As such, it will be the responsibility of the Contractor to ensure that a master record set of the plans is maintained throughout construction to document all installations and any deviations from the design shown in the contract documents.
- B. It is the responsibility of the Contractor to maintain written records of daily construction progress, areas worked and quantities installed to aid in the completeness of as-constructed documentation.
- C. The Contractor shall adhere to the City of Sioux City *AS-BUILT RECORD DRAWING REQUIREMENTS* (2013).

1.06 Charging of Working Days

Saturdays will be considered a working day under this contract.

PART II TECHNICAL PROVISIONS

This part consists of the material requirements, construction details, and methods of measurement and basis of payment necessary to complete construction of the Gordon Drive Traffic Signal Coordination project, in place, as described in the contract documents.

2.01 General

A. Material

Supply only new materials from reputable suppliers and manufacturers approved by the Engineer. Provide any items, equipment, or materials not specifically addressed in the contract documents but required to provide a complete and functional installation. The level of quality shall be consistent with other specified items. All miscellaneous electrical equipment and materials shall be UL-approved. Securely store and protect all materials delivered to the project site. Provide appropriate material quantities for testing or verification at no additional cost when requested by the Engineer.

B. Construction

The Contractor shall expect some reasonable variation in location of the facilities shown due to unforeseen conflicts, changes in proposed work, installation difficulties, or other circumstances. The Engineer shall authorize any changes in location in writing before performing the installation. No additional compensation shall be provided for additional work associated with or resulting from unauthorized changes to the contract documents.

2.02 Traffic Control

All traffic control on this project shall comply with Article 2528 of the Standard Specifications and the contract documents.

A. Materials

All signs for traffic control zones shall be mounted and maintained on Iowa DOT approved moveable skids regardless of expected duration.

B. Construction

1. The Engineer shall provide any required detour routes and detour route signage at no cost to the Contractor. All lane, ramp, and roadway closures are subject to the limitations stated in the contract documents and the approval of the Engineer.
2. Request any such closures a minimum of 5 days prior to the desired closure date. The decision of the Engineer regarding a request shall be final. Closures of convenience will not be permitted.
3. The Contractor shall maintain daily, and submit when requested, an Iowa DOT traffic control monitor checklist and diary. Found at:
http://www.iowadot.gov/construction/traffic_safety/tc_monitor_wz_checklist.xls
4. Work completed under this contract will require brief signal shutdowns at each signalized intersection in order for replacement / installation of meter pedestals and traffic signal controller changeovers including any associated signal cable splicing. The Contractor shall avoid traffic signal shutdowns during the peak hours of traffic flow (7:00 – 9:00 AM and 4:00 – 6:00 PM). No more than one traffic signal shall be shut down during simultaneous times without prior approval from the Engineer. Traffic signal shutdowns shall not exceed 12 hours at any single signalized intersection. The Contractor shall contact the City of Sioux City and MidAmerican Energy 48 hours in advance to schedule all proposed shutdowns.

5. The Engineer shall resolve all conflicts.

2.03 Demo Items - Salvage

A. Materials

None.

B. Construction

1. Remove Traffic Signal Controller & Components

- a. The Contractor shall remove signal controller and components as indicated on the plans or as directed by the Engineer.
- b. These items will be salvaged and therefore care should be given during removal to minimize damage (structural and operational).
- c. The Contractor will not relocate (deliver) salvaged items. The Contractor shall coordinate with the City of Sioux City prior to removing these items as the City will pick up salvaged items onsite.
- d. The Contractor shall not remove the existing traffic signal controller until the new traffic signal controller at that intersection is operational.

2. Remove Cabinet

- a. The Contractor shall remove cabinets as indicated on the plans or as directed by the Engineer.
- b. This does not include removal of the footing.
- c. These items will be salvaged and therefore care should be given during removal to minimize damage (structural and operational).
- d. The Contractor will cut and/or grind the existing anchor bolts flush with the footing.
- e. The Contractor will not relocate (deliver) salvaged items. The Contractor shall coordinate with the City of Sioux City prior to removing these items as the City will pick up salvaged items onsite.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for removing items to be salvaged shall be paid for at the lump sum contract unit price bid for the pay item Removal of Traffic Signalization.
2. Payment is full compensation for:
 - a. The complete removal of the item indicated.
 - b. Coordinating with the City of Sioux City a pick up time prior to removing the items.
 - c. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.04 Demo Items

A. Materials

None.

B. Construction

1. Remove Meter Pedestal

- a. The Contractor shall remove meter pedestals as indicated on the plans or as directed by the Engineer.
- b. The Contractor shall promptly dispose of the materials off-site.
- c. The Contractor shall coordinate all meter pedestal removals with MidAmerican Energy.

2. Remove Handhole

- a. The Contractor shall remove handholes as indicated on the plans or as directed by the Engineer.
- b. The Contractor shall promptly dispose of the materials off-site.
- c. The Contractor shall backfill the area where the handhole was removed to match the existing grade elevation.

3. Remove Cable

- a. The Contractor shall remove existing cables as indicated on the plans or as directed by the Engineer.
- b. The Contractor shall promptly dispose of the materials off-site.
- c. Multiple cables in the same conduit shall be treated as one.
- d. The bid unit shall refer to removal in a given conduit segment regardless of length.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for removing items to be salvaged shall be paid for at the lump sum contract unit price bid for the pay item Removal of Traffic Signalization.
2. Payment is full compensation for:
 - a. The complete removal of the item indicated.
 - b. Coordinating with MidAmerican Energy.
 - c. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.05 Core Drill Footing

A. Materials

None.

B. Construction

1. The Contractor shall core drill through an existing cabinet footing as necessary to install conduits as indicated in the plans or as directed by the Engineer.
2. The penetration of the footing wall shall be a minimum of 12 inches below grade.
3. Both the wall and top penetrations shall be sealed to a watertight condition.
4. A drill shall be performed for each conduit to be installed.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for core drilling shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
2. Payment is full compensation for:
 - a. The core drilling of footings shown in the plans.
 - b. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.06 Footing Extension

A. Materials

1. All concrete shall meet the requirements of Article 2403 of the Standard Specifications and current supplements except as noted.
2. Use Class C concrete for cabinet footings.

B. Construction

1. The Contractor shall extend existing traffic signal footings per the dimensions and orientation indicated on the plans.
2. The footing extension shall match the height of the existing footing.
3. The installation shall include expansion joints and tie bars.
4. This work does not include a maintenance pad.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for footing extension shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
2. Payment is full compensation for:
 - a. Constructing footing extensions as shown in the plans.
 - b. Including surface excavations, repair or restoration of any nearby areas, concrete, steel reinforcement, and anchors.
 - c. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.07 3 Foot Apron

A. Materials

1. All concrete shall meet the requirements of Article 2403 of the Standard Specifications and current supplements except as noted.
2. Use Class C concrete for cabinet footings.

B. Construction

1. The Contractor shall construct a 3 foot maintenance pad in front of a signal cabinet footing as indicated in the plans.
2. The width of the apron will match the footing.
3. Tie bars shall be installed between the apron and footing.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for 3 foot aprons shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
2. Payment is full compensation for:
 - a. Constructing an apron as shown in the plans.
 - b. Including surface excavations, repair or restoration of any nearby areas, concrete, steel reinforcement, and anchors.

- c. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.08 Conduit

A. Materials

1. High Density Polyethylene (HDPE) conduit

- a. High Density Polyethylene (HDPE) conduit shall be smooth wall ORANGE.
- b. HDPE shall be SDR 13.5 minimum and meet or exceed ASTM D3035/F2160/NEMA TC-7 EPEC-B standards.
- c. HDPE shall be manufactured from thermoplastic polymer conforming to the minimum standard of PE334470E/C as defined in ASTM D3350.
- d. Sequential foot markings should be printed on HDPE.
- e. A custom message of stated material specifications that product meets shall be printed a minimum of every 10 feet on conduit.
- f. Conduit shall be UL 651 listed.

B. Construction

1. General

- a. Follow all general guidelines covering the construction of buried conduit.
- b. Install conduit by plowing, jacking, pushing, boring, structure attachment or other approved methods within the public right of way and in a manner that minimizes atypical damage from construction operations.
- c. The minimum bending radius of HDPE conduit shall be the larger of twenty times the outside diameter or the HDPE manufacturer's recommendations for minimum bending radius.
- d. Open trench installation is only permitted within 25 feet of any handhole, pole, structure, or other similar improvements, and any other requested locations approved by the Engineer.
- e. At the discretion of the Engineer, verify the integrity of the conduit structure in a manner acceptable to the Engineer.
- f. Tunneling under the pavement or water jetting shall not be permitted.
- g. No excavations are permitted to cross any roadways or any other paved or other similarly improved areas. At these locations, install conduits by boring method unless otherwise directed or approved in writing by the Engineer. Where indicated in the contract document and at all roadway and stream crossings, install conduit sections with external protection as specified herein.
- h. No direct-buried cable is allowed.
- i. Unless otherwise indicated in the contract documents, installation of Schedule 40 PVC conduit or approved alternative is allowed only in open trench runs or when approved by the Engineer.
- j. Seal all conduit openings using an approved sealing compound (ductseal) at all conduit openings at the handholes and cabinets.

2. Installation Clearances

- a. Depth of all bores shall be a minimum of 42 inches unless otherwise specified in the plans.
- b. Maintain the minimum depth throughout the length of all conduit installations.
- c. Maintain a minimum of 2 feet of separation when underground conduits parallel an existing facility.

3. Conduit Splicing

- a. All mechanically joined conduit splices shall use compression couplings designed for underground placement and blown-in fiber installation.
- b. Electrofusion joining of HDPE conduit will be allowed provided that method used does not create a ridge on the inside of the conduit that may impact future fiber installation.
- c. Butt fusion welding and solvent welding of conduits will not be allowed.
- d. All conduit splices shall be watertight to 200 psi.
- e. Conduit splicing is incidental to the connected items of work.

4. Facilities Protection

- a. The Contractor is responsible for protecting and maintaining the conduit throughout construction and until final acceptance.
- b. To avoid possible damage to buried conduit from exposure to traffic, livestock and other hazards, complete trenching of laterals, trenching around culverts, construction of aerial inserts and similar operations as soon as practicable behind all segment installations.
- c. If more than 48 hours lag is expected behind a segment installation, install additional protective measures acceptable to the Engineer.

5. Backfilling

- a. Backfill trenches and other excavations in lifts of 6 inches or less in compacted depth. Compact each layer thoroughly before placing subsequent layers.
- b. Remove all cinders, broken concrete, or other hard or abrasive materials in the backfill material before commencing backfilling operations.
- c. Remove and dispose of surplus and unsuitable materials upon completion of the backfilling operations in the area.
- d. Place and carefully hand tamp backfill under and around the structures in lifts not to exceed 4 inches in loose thickness. Use a suitably sized mechanical tamper for all areas inaccessible to rollers. Operate pneumatic or other mechanical tampers in accordance with the manufacturer's recommendations.
- e. Perform operations in a manner that minimizes soil erosion and employs appropriate storm water pollution prevention measures during all construction operations.
- f. Maintain work areas in a neat, clean, and orderly condition at all times.
- g. Upon completion of conduit/cable placing operations and any other work in an area, remove all debris, materials, tools, and equipment from the area and restore the disturbed area(s) to original or better condition within 24 hours or as soon as practicable as determined by the Engineer. Backfill all excavations and grade all disturbed areas during the restoration process.
- h. Remove and dispose of rock and debris excavated and remaining after backfilling as directed by the City of Sioux City.
- i. Immediately repair or replace any unauthorized disturbance or damage. Replace improved landscaping, lawns, scrubs, and hedge removed or damaged during construction in a manner acceptable to the Engineer. Re-sod damaged lawns using like grasses. All restoration work shall be subsidiary to other work being performed.

6. Multiple Duct Installation

Install multiple ducts, in continuity, at locations indicated in the contract documents unless authorized in writing by the Engineer.

7. Plowing

- a. Use equipment and construction methods subject to the approval of the Engineer that cause minimal displacement of the soil.
- b. Furnish competent supervision at all times at the site of plowing operations to assure compliance with the contract documents.
- c. The equipment shall be capable of extending the plow in order to maintain the required minimum depths under all terrain conditions.
- d. The reel carrier shall be of adequate size and be configured so that the reel sizes being used can be safely handled.

- e. Avoid damaging any paved surfaces, ditches, or other similar surface features. Immediately repair any damage to such features to the satisfaction of the Engineer.
- f. Perform plowing in accordance with standard industry practices using a prime mover with hydrostatic type steering and a vibratory plow. The design of the plowshare shall be such that the buried conduit passing through the plow shall not bind and shall not be bent in a radius less than twenty times the outside diameter of the conduit and maintains the structural integrity of the conduit. The feed chute shall have a removable gate for the purpose of inspection and to allow the conduit to be removed from or inserted into the feed chute at any intermediate point between splice locations. The conduit path inside the feed chute shall have low friction surfaces and be free of burrs and sharp edges to prevent damage to the conduit as it passes through. Smooth any welds before use. Internal guide rollers shall not be used. Exercise care during the plowing operation to avoid conduit damage. Feed the conduit into the ground through the plow loose and at no tension.
- g. Excavate as needed start and finish pits and pits at points of intersection in advance of plowing. Expose ends of casings and crossings of foreign utilities before the start of plowing operations for a conduit segment. Exercise care in the use of trenching and excavating tools and equipment to avoid damaging installed and intersecting conduits or other facilities.
- h. Restore plow furrowed areas to conform to the surrounding terrain using a rubber tired tractor or heavy truck or a vibratory roller having a weight of three tons and a drum width between 4 and 6 feet or by other suitable means approved by the Iowa DOT.

8. Conduit In Trench

- a. Use equipment and construction methods subject to the approval of the Engineer that cause minimal displacement of the soil.
- b. Excavate open trench straight as practicable. Shape the trench to be smooth, free from any sharp edges, and clear of debris and loose rock. Excavate only gradual grade changes.
- c. Do not leave trenches unattended at any time or open during non-working hours unless approved in writing by the Engineer. Install barriers or other protective measures to prevent livestock or persons from falling into an open trench when appropriate.
- d. Notify the Engineer immediately if solid rock is encountered at any location. Excavate rock trenches using a rock saw or other suitable equipment. The excavation, backfill, and road crossings in solid rock areas shall conform to the requirements stated above unless specifically exempted in this section.

9. Bored Crossings

- a. Use equipment and construction methods subject to the approval of the Engineer that cause minimal displacement of the soil.
- b. Bore all crossings beneath roadways, streets, other paved surfaces, railroads, or other structure in accordance with requirements and regulations of the authority having jurisdiction and as directed in the contract documents
- c. Limit bore hole sizes to the outside diameter of the conduit being placed.
- d. Locate bore pits a minimum of 2 feet from the edge of pavement or shoulder unless otherwise directed by the Engineer.

C. Method of Measurement & Basis of Payment

- 1. Measurement and payment for all conduit shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
- 2. Payment is full compensation for:
 - a. The furnishing and installation of all conduits per the contract documents.
 - b. Including all surface excavations or surface preparation work, repair or restoration of any disturbed areas to pre-construction conditions, proper water/moisture drainage materials.

- c. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.09 Handholes

A. Materials

1. General

- a. Supply handholes constructed of epoxy or polyester resin mortar with woven glass fiber reinforcement and an appropriate aggregate dimensioned as indicated in the contract documents.
- b. Handhole materials shall not support combustion when tested in accordance with "Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position" ASTM D-635.
- c. Water absorption shall not exceed two percent of the original weight of material under test conditions per "Standard Test Method for Water Absorption of Plastics" ASTM D-570.
- d. The handhole shall be functional without failure throughout a temperature range of -50 to +170 °F.
- e. The handhole walls shall not deflect more than 0.024 inches per foot of length of box when installed and subject to an ASTM C-857 TIER 22 load.
- f. Handholes shall meet ANSI/SCTE 77 standards and be verified by a registered third party and stamped by a registered Professional Engineer.
- g. Handhole lid strength shall be tested to 22,500 lbs (Tier 15).
- h. Handhole lids shall be labeled as indicated in the plans or as directed by the Engineer.
- i. The Engineer shall provide approval prior to use of any handholes satisfying the contract documents requirements for structural, physical, and chemical properties.
- j. The handholes shall be UL listed.

B. Construction

- 1. Install the type and size of handholes at the locations indicated in the contract documents.
- 2. Construct all handholes as located on the plans.
- 3. Set handholes flush with the surface when constructing in a sidewalk or driveway. Set handholes approximately 1 inch above the finished surface of the surrounding ground when constructing in an earth embankment or non-paved surface.
- 4. Install course aggregate bedding to a depth of 1 foot below the handhole.
- 5. Conduit shall enter the handhole from the bottom and extend conduit ends between 4 and 6 inches above the aggregate bedding.
- 6. Side penetrations of the handholes are not permitted.
- 7. Plug all open conduit ends within the handhole in a manner acceptable to the Engineer.
- 8. Rodent proof all handholes to the satisfaction of the Engineer.

C. Method of Measurement & Basis of Payment

- 1. Measurement and payment for all handholes shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
- 2. Payment is full compensation for:
 - a. The furnishing and installation of all handholes,

- b. Including all surface excavations, repair or restoration of any nearby areas, concrete, proper water/moisture drainage materials, all necessary electric grounding materials and installation,
- c. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.10 Traffic Signal Cabinet

A. Materials

1. Cabinet Shell

- a. Contractor shall furnish Size P38 cabinets, clean cut in design and appearance to house the control equipment and having the maximum dimensions: 55 inches high, 38.25 inches wide, and 26 inches deep.
- b. Cabinets shall be new, corrosion resistant, UL-50 approved, NEMA TS2 compliant, constructed of welded sheet aluminum type 5052-H32 with a minimum thickness of 0.125 inch, complete with all internal components, back and side panels, terminal strips, and mounting hardware compatible with either ECONOLITE ASC/3-2100 or SIEMENS EPAC 300 signal controllers.
- c. Two mounting shelves shall be provided.
- d. The aluminum shall be smooth and the exterior shall be left in its unpainted natural color.
- e. The cabinet structure shall be effectively sealed to prevent the entry of rain, dust, and dirt.
- f. All exterior seams for cabinet and doors shall be continuously welded.
- g. Submit cabinet design and equipment layout details to the Engineer for review and approval prior to fabrication.

2. Cabinet Doors

- a. The cabinet door shall be sturdy, torsionally rigid, and attached by a heavy gauge aluminum butt hinge utilizing a stainless steel hinge and carriage bolted in place for ease of door removal.
- b. The door shall substantially cover the full area of the front of the cabinet.
- c. The cabinet door shall be provided with a three position automatic door stop positioning mechanism.
- d. A closed-cell neoprene door gasket shall be provided to act as a permanent and weather resistant seal at the cabinet door facing.
- e. A heavy-duty clear plastic envelope shall be provided, securely attached to the inside wall of the cabinet or cabinet door, for stowing cabinet wiring diagrams and equipment manuals.
- f. The envelope shall have minimum dimensions of 9 inches wide by 12 inches deep.
- g. A ventilation fan controlled by a thermostat and suitable dust filters for the capacity of the ventilating system shall be provided.
- h. The filters shall be dry type, easily removed and replaced, and standard dimensions commercially available.
- i. Ventilation fan shall be fused separately and wired after the main AC+ circuit breaker.
- j. Each cabinet door shall be provided with a high quality, heavy duty tumbler-type lock.
- k. Two, #2 keys for each tumbler lock shall be provided for each cabinet.
- l. Keys shall be given to the City of Sioux City.
- m. Do not attach keys to the exterior of the cabinet at any time during storage or installation.
- n. In addition to the main door of the controller cabinet, there shall be an auxiliary police door provided in the main door provided with a strong lock and two keys of different design than that of the main door of the cabinet.
- o. The panel behind the auxiliary police door shall contain a switch to change from normal function to flashing operation.
- p. The controller shall remain in full operation during flash operation.

- q. Provide a signal on-off switch to interrupt power to the signal heads only and continue controller operation.

B. Construction

1. The Contractor shall mount the cabinet on the existing footing and/or footing extension as necessary.
2. This shall include drilling anchor bolts into the existing footing where necessary.
3. Install power connections in accordance with the contract documents and all NEC requirements.
4. Contractor shall coordinate installations in advance as noted in the contract documents.
5. Contractor shall provide all conduit, breaker enclosures, circuit breakers, wiring and accessories, neutral bars and accessories, ground bars and accessories, terminations and grounding in the power source.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all traffic signal cabinets shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
2. Payment is full compensation for:
 - a. The furnishing and installation of all signal cabinets per the contract documents.
 - b. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.
 - c. Including mounting materials, cable pulling, routing, and termination for cables to the proper termination panel, and all necessary electric grounding materials.

2.11 Battery Backup System (BBS)

A. Materials

Furnish, assemble, fabricate, and install new corrosion resistant materials in accordance with specifications. Supply a "rack mountable" UPS unit, including a front panel with indicators and controls switches.

1. Cabinet Shell

- a. The cabinet shall be capable of either side mount or ground (footing) mount installation.
- b. The cabinet will house batteries, UPS, and bypass switches.
- c. The cabinet must meet the requirements for NEMA 3R enclosures.
- d. The housing must have the dimensions so that it may easily be attached to the side of an M, P, P38, or 332 Type traffic signal cabinet.
- e. Dimensions of the cabinet shall not exceed: 50 inches high, 20 inches wide, and 17 inches deep.
- f. The cabinet must not interfere with the opening of the signal cabinet door.
- g. The complete enclosure and door must be made from 0.125 inch thick aluminum.
- h. All external seams must be continuously welded. The door opening must have a double flange for weather sealing purposes.
- i. The entire enclosure must be natural aluminum.
- j. Vents and a thermostatically controlled exhaust fan shall be installed in the cabinet.

2. Cabinet Doors

- a. The cabinet must have a door to provide access to the complete cabinet interior.

- b. The door must be mounted on a continuous piano hinge.
- c. The key lock must be a Corbin cylinder lock with a #2 key.
- d. A continuous neoprene gasket must be used to weatherproof the enclosure when the door is closed.

3. Battery System

- a. Individual batteries shall be easily replaced and commercially available on the shelf.
- b. Batteries shall be maintenance free, type AGM/VRLA (Absorbed Glass Mat/Valve Regulated Lead Acid).
- c. The batteries must be designed for stand-by applications.
- d. Batteries shall be certified by the manufacturer to operate over a temperature range of -25 °C to +74 °C.
- e. Batteries shall have a minimum Manufacturer's Warranty of 2 Years Full Replacement from date of delivery.
- f. The Warranty shall cover any battery that does not meet 80% of its original reserve capability during the warranty period.

4. Functional Requirements

- a. This specification is for establishing the minimum requirements for a complete emergency battery backup system for use with Light Emitting Diode Traffic Signal Modules at traffic signals with NEMA, 170 or 2070 controllers.
- b. The Battery Backup System (BBS) shall include, but not be limited to the following: Inverter/Charger, Batteries, a separate automatic and manually operated Bypass Switch, and all necessary hardware and interconnect wiring.
- c. The BBS shall be capable of providing power for both the full normal operation of a traffic signal with all LED displays (all colors: red, yellow, green and pedestrian heads), and flashing mode operation with all LED displays.
- d. The BBS shall be designed for outdoor applications.

5. BBS Unit

- a. The BBS shall provide a minimum 2 hours of full run-time operation with an additional 4 hours minimum of Red Flash operation at an LED only traffic signal with a maximum 800 W active output load.
- b. The inverter, when on batteries, shall operate with a minimum efficiency of 84% with a load ranging from 25% to 90% of the BBS total output rating.
- c. The BBS shall operate at 97% or higher when operating under normal condition (utility power is available).
- d. The maximum transfer time allowed, from disruption of normal utility line voltage to stabilized inverter line voltage from batteries, shall be 5 milliseconds.
- e. 5 milliseconds maximum allowable transfer time shall also apply when switching from inverter line voltage to utility line voltage.
- f. The BBS shall include a Fail Safe Automatic/Manual Bypass Switch for bypassing the UPS for maintenance.
- g. The FS-ATS bypass switch will be a 3-stage configurations, UPS Normal mode, bypass UPS on and bypass UPS off.
- h. The BBS shall provide six sets of programmable output contacts. These shall include: One output to indicate the system is "on battery". One output to indicate a programmable low battery condition.
- i. The BBS will provide a visual indication for each output when activated.
- j. The BBS shall provide inputs to turn the BBS off and to start the self-test.
- k. Operating temperature for both the inverter/charger, and manual bypass switch shall be -37 °C to +74 °C.
- l. The Fail Safe ATS Bypass Switch shall be rated at 240VAC/30 amps, minimum.
- m. The BBS shall use a temperature compensated charging system. The BBS shall employ a charging system that balances the charge across all the batteries.

- n. BBS shall bypass the utility line power whenever the utility line voltage is outside of the following voltage range: 85VAC to 175VAC (\pm 2VAC).
- o. During a utility input from 85 VAC to 175 VAC the UPS shall maintain a full load output of 108 VAC to 131 VAC at 60Hz.
- p. When utilizing battery power, the BBS output voltage shall be between 110 VAC and 128 VAC, pure sine wave output, \leq 3% THD, 60Hz \pm 3Hz.
- q. BBS shall be compatible with NEMA, 170 or 2170 Controllers, and cabinet components for full time operation.
- r. All loads to the maximum rating of the BBS shall be powered through the BBS system to utilize the UPS internal over/under voltage regulation.
- s. BBS shall be equipped to prevent a malfunction feedback to the cabinet or from feeding back to the utility service.
- t. In the event of inverter/charger failure, battery failure or complete battery discharge, the Fail Safe Transfer Switch shall revert to the NC (and de-energized) state, where utility line power or generator power, if available, is connected to the cabinet.
- u. Recharge time for the battery, from "protective low-cutoff" to 90% or more of full battery charge capacity, shall not exceed 8 hours, unless limited by the Temperature Regulated charger due to excessive battery heat.
- v. The battery charger will be compatible with the specified batteries.
- w. The BBS shall have lightning and surge protection compliant with IEEE/ANSI C.62.41.
- x. The BBS shall be equipped with an integral system to prevent battery from destructive discharge and overcharge.

6. Maintenance

- a. The BBS shall include a display and /or meter to indicate current battery charge status and conditions.
- b. The BBS and batteries shall be easily replaced with all needed hardware and shall not require any special tools for installation.
- c. The BBS shall display via a front panel indicator the number of times the BBS was activated and the total number of hours the unit has operated on battery power.
- d. The status display shall show the UPS mode, Alarm status, Input and output voltages, Output current, Battery voltage, battery charger current and last event.
- e. The BBS shall include two separate communication ports, an RJ-45, 1000/100 Ethernet port and a DB-9, RS 232 serial port. All programming and monitoring functions shall be available through either port.
- f. The BBS shall include software for programming and monitoring the BBS. The software shall be capable of being used on a PC with all current Microsoft operating systems.
- g. Manufacturer shall include a set of operation manuals and wiring diagrams of the BBS with each BBS.

B. Construction

- 1. The Contractor shall mount the cabinet on signal cabinets as indicated on the plans.
- 2. The Contractor shall furnish and install all necessary galvanized conduit, fittings, and gaskets necessary to allow cables between the cabinet and the signal cabinet.

C. Method of Measurement & Basis of Payment

- 1. Measurement and payment for all battery backup systems shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
- 2. Payment is full compensation for:
 - a. The furnishing and installation of all battery backup systems per the contract documents.
 - b. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

- c. Including mounting materials, cable pulling, routing, and termination for cables to the proper termination panel, and all necessary electric grounding materials.

2.12 Cabinet Mounted Meter

A. Materials

A 100 Amp Main Circuit breaker with two additional breakers for traffic signal and lighting shall be installed in the cabinets. The sizes of additional breakers shall be coordinated with signal cabinet manufacturer for signal and MidAmerican Energy for lighting.

B. Construction

Contractor shall supply and install a cabinet mounted meter per MidAmerican Energy requirements.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all power connections shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
2. Payment is full compensation for:
 - a. The furnishing and installation of all cabinet mounted meters as shown in the contract documents,
 - b. Furnishing all materials, labor, equipment, and other incidental items including supply and installation of cable splices and connectors, circuit breaker, coordination with MidAmerican Energy, and slack/coiled/stored cables as necessary to meet the requirements of the contract documents.

2.13 Power Connections

A. Materials

Power connections shall comply with the requirements of NEC, the contract documents and all generally accepted standards and requirements for the electrical components and power terminations in the individual power source.

B. Construction

1. Install power connections in accordance with the contract documents and all NEC requirements.
2. Contractor shall coordinate installations in advance as noted on the contract documents.
3. Contractor shall provide all conduits, breaker enclosures, circuit breakers, wiring and accessories, neutral bars and accessories, ground bars and accessories, terminations and grounding in the power source.
4. Unless otherwise directed by the Engineer, the Contractor shall install the power connections as indicated in the plans.
5. The Contractor is responsible for coordinating with MidAmerican Energy and scheduling all locally required inspections of electrical work prior to putting a location into service and for all permitting requirements.
6. The Contractor shall coordinate with MidAmerican Energy to request that electrical service at a device location be initiated.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all power connections shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
2. Payment is full compensation for:
 - a. The furnishing and installation of all power connection accessories as shown in the contract documents,
 - b. Including the proper installation of the conduit, breaker enclosures, circuit breakers, wiring and accessories, neutral bars and accessories, ground bars and accessories, terminations, and grounding in the power source.
 - c. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.14 Traffic Signal Controller**A. Materials****1. Signal Controller**

- a. The Contractor shall furnish and install an ECONOLITE ASC/3-2100 or SIEMENS EPAC 300 traffic signal controller as indicated in the plans.
- b. The controller shall be configured for shelf mounting.
- c. The controller shall allow for a time-based control with fiber optic and/or radio communications.
- d. Controllers shall allow for Ethernet support for a 1000/100 Base T network and be supplied with a Data Key Module for use as a database storage device (backup).

2. Auxiliary Components

- a. The Contractor shall furnish and install a conflict monitor and flasher module that is NEMA TS2 compliant and compatible with the traffic signal controller.
- b. Any additional material or installation requirements relating to auxiliary components as stated in Part 2.02, 2.03, and 2.04 of Section 8050 of the current SUDAS edition shall be met.
- c. CAT 6 patch cords shall be CommScope, Panduit, or Ortronics (or approved equal).
- d. All category 6 patch cords shall use 4-pair balanced twisted-pair category 6 No. 23 AWG stranded twisted pair copper cable and be Booted.
- e. The cords must be available in various lengths.

B. Construction

1. The Contractor shall supply and install controllers and auxiliary components.
2. The Contractor shall perform all work necessary to program the controllers at every intersection to timing plans provided by the City of Sioux City. This includes coordination between intersections.
3. To achieve the programming, it will be necessary to have a representative from the controller and auxiliary component manufacturers or vendor on site to program and trouble shoot. All programming and trouble-shooting will be subsidiary to the bid item for which payment is being made.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all traffic signal controllers shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.

2. Payment is full compensation for:
 - a. The furnishing and installation of all signal controllers and auxiliary components per the contract documents.
 - b. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.
 - c. Furnishing of all materials, labor, equipment, and other incidental items necessary to program and trouble shoot signal controllers.

2.15 Wire and Cable

A. Materials

1. Tracer Wire

Single conductor, stranded copper, Type THHN, No. 12 AWG with UL approval and orange colored jacket.

2. Pull Tape

Sequentially numbered with a minimum proper tensile strength of 2670N.

3. Grounding/Bonding

Ground all installations using a No. 6 AWG copper, non-insulated wire bonded to copper-clad metal, driven electrodes using an exothermic weld.

B. Construction

1. General

- a. All installations and connections shall comply with the contract documents and all generally accepted codes and standards.
- b. Install cable connectors in accordance with Standard Road Plan RM-40 and the contract documents at the base of all breakaway poles, cabinets, or other installations for all non-low voltage installations unless otherwise directed by the Engineer. All costs associated with these connectors are incidental to the cost of the connected items of work.
- c. The Engineer shall resolve all conflicts.

2. Tracer Wire

- a. Install, splice, and test for continuity tracer wire in all conduit installations as indicated on the contract documents.
- b. Splice tracer wires as needed in the Fiber Vault Handholes to form a continuous network using UL tested for wet location splice kits.
- c. Terminate each tracer wire run in the Locate Box on the signal cabinet with labeling to verify direction.
- d. Maintain the continuity of the tracer wire through Type FOR27 pulling handholes.

3. Pull Tape

Install in conduits as indicated in the plans.

4. Grounding/Bonding

- a. Ground all installations as indicated in the contract documents.
- b. Installation of grounds is incidental to the cost of the connected items of work.
- c. Ground all installations in accordance with the requirements of NEC. Supply and install additional grounding rods and equipment as necessary to satisfy such requirements at no additional cost to the Owner.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all wire and cable shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
2. Payment is full compensation for:
 - a. The furnishing and installation of all wire and cable.
 - b. Including the proper installation of the wire and cable into existing conduit and new conduit systems, supply and installation of splices and connectors, and slack, coiled, or stored wires or cables.
 - c. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

2.16 Fiber Optic Cable

A. Materials

1. General

- a. The cable shall meet the latest applicable standard specifications by American National Standards Institute (ANSI), Electronic Industries Association (EIA) and Telecommunications Industries Association (TIA) for the single-mode fiber cable of the size specified per the plans.
- b. All fiber optic cable for installation on this project shall be provided by the Contractor.
- c. 144 SM Fiber shall be ordered as a single reel. No end reel splices of the 144 SM Fiber will be allowed.

2. Single-mode Fiber Optic OSP Cable – Dielectric Loose Tube

- a. Fiber optic, single-mode, graded loose tube dielectric cable constructed with industry standard 3mm buffer tubes stranded around a central strength member.
- b. The buffer tubes shall be compatible with standard hardware and shall have 12 fibers per tube, the fibers shall not adhere to the inside of the buffer tube, each fiber shall be distinguishable by means of color coding in accordance with TIA/EIA-598-B and be colored with ultraviolet (UV) curable ink.
- c. The cable core shall be water blocked with dry water blocking materials to improve access and handling of individual tubes.
- d. The cables shall be designed for point-to-point applications as well as mid-span access, and provide a high-level of protection for fiber installed in the outside plant environment.
- e. Single-mode, dispersion-unshifted fiber meeting ITUT G.652D requirements.
- f. The fiber shall be fully capable of handling existing and legacy single-mode applications which traditionally operate in the 1310 nm and 1550 nm regions and shall also be designed to operate the full-spectrum from 1260 nm to 1625 nm for optical transmission.
- g. The fiber shall be designed to provide optimum performance from 1260 nm to 1625 nm intended for 16-channel Course Wavelength Division Multiplexing applications.
- h. Cables shall be sheathed with medium density polyethylene (MDPE). The minimum nominal jacket thickness shall be 1.3 mm. Jacketing material shall be applied directly over cable core and water swellable tape. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.
- i. The MDPE jacket material shall be as defined by ASTM D1248, Type II, Class C, Category 4 and Grades J4, E7 and E8.
- j. The jacket or sheath shall be free of holes, splits, and blisters.
- k. The cable jacket shall contain no metal elements and shall be of a consistent thickness.
- l. Cable jackets shall be marked with the manufacturer's name, month and year of manufacturer, sequential meter or foot markings, a telecommunication handset symbol as required by Section 350G of the National Electrical Safety Code (NESC), fiber count, and fiber type. The actual length of the cable shall be within -0/+1% of the length markings. The print color shall be white, with the exception that cable jackets containing

one or more coextruded white stripes, which shall be printed in light blue. The height of the marking shall be approximately 2.5 mm.

- m. The maximum pulling tension shall be 600 lbf during installation (short term) and 200 lbf long term installed.
- n. The shipping, storage, and operating temperature range of the cable shall be -40 °C to +70 °C. The installation temperature range of the cable shall be -30 °C to +70 °C.

B. Construction

1. General

- a. Remove fiber optic cable from the reel in a manner acceptable to the Manufacturer and Engineer.
- b. Install fiber optic cable in conduit system as indicated in the contract documents.
- c. Direct bury of fiber optic cable is not allowed.
- d. Do not twist or bend the fiber optic cable in excess of the limits recommended by the manufacturer.
- e. As the cable is fed into the duct and conduit system the Contractor shall use a manufacturer approved water-based cable lubricant for all fiber optic cable installations.
- f. Protect at all times all proposed cables, cable ends, and any exposed portions of fiber optic cable from damage including water intrusion.
- g. Any existing pull tape or tracer wire that is used as a pull rope for fiber optic cable installation shall be replaced in kind. The cost of any tracer wire or pull tape replacement shall be subsidiary to the fiber optic cable installation.

2. Cable Installation

- a. All fiber optic cable shall be installed in conduit.
- b. A suitable cable feeding method shall be used between the cable reel and the face of the duct and conduit to protect the cable and guide it into the duct.
- c. Dynamometers and breakaway pulling swings shall be used to ensure that the pulling line tension does not exceed 600 pounds.
- d. The mechanical stress placed on a cable during installation shall not be such that the cable is twisted or stretched. A pulling eye and swivel shall be attached to the cable and used to install the cable through the duct conduit system to prevent the cable from twisting.
- e. Cables shall not be forced around sharp corners and precautions shall be taken during installation to prevent the cable from being kinked or crushed.
- f. Minimum bending radius during installation shall not be less than twenty times the outside diameter of the cable or as recommended by the manufacturer, whichever is greater.
- g. Pulling of the cable shall be hand assisted.
- h. Iowa DOT approved installation methods include Pulling, High Air Speed Blowing, Air-Assist, Push/Pull Installation, and Air Blown Cable. Installation must comply with all manufacturers' recommendations for cable installation including pulling tensions and bending radii.
- i. The cable shall be carefully inspected for jacket defects. If defects are noticed, the pulling operation shall be stopped immediately and the Engineer notified. The Engineer shall make a determination of acceptability of shall reject the cable.
- j. The fiber cable shall be installed in continuous runs as marked on the plans. No splices shall be allowed unless indicated by the plans or approved by the City of Sioux City.
- k. Seal all conduit openings using an approved sealing compound (duct seal) at all conduit openings at the handholes and cabinets after cable installation.

3. Facilities Protection

- a. In the event it is suspected that cable damage has occurred prior to final acceptance, Contractor shall test the cable with an OTDR within (72) hours after notification and submit a copy of the OTDR test to the Engineer upon completion.

- b. Contractor shall replace or repair, as directed by the Engineer, any damage occurring before final acceptance at no additional cost to the City of Sioux City. Perform any repairs or replacements as soon as reasonably possible unless otherwise approved by the Engineer.
- c. Contractor shall repair or replace any defect in the installed cable at no additional cost to the City of Sioux City. Consider a defect to be any condition resulting in a negative or adverse effect on current or future operations of the completed fiber optic communication system as determined by the Engineer.
- d. Any existing wiring that is damaged during fiber optic cable installation shall be replaced or repaired, as directed by the Engineer, at no additional cost to the City of Sioux City.

4. Slack Coils

- a. Sufficient slack shall be left at each end of the cable to allow proper cable splicing and termination. The minimum slack amount shall be as follows or as indicated in the plans:
 - Handhole, type FOR27 – 60 feet
 - Handhole, type Fiber Vaults – 150 feet
- b. Storage of slack cable in cabinets and handholes shall be neatly coiled. The slack coils shall be bound at a minimum of three points around the coil perimeter. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames and terminals.
- c. For storage purposes, the minimum bending radius shall not be less than ten times the outside diameter of the cable or as recommended by the manufacturer, whichever is greater.

5. Cable Identification

- a. Place tags on all fiber optic cable identifying the owner and direction of the cable.
- b. Tags shall clearly identify where each individual cable run originated and where it ends (handhole to handhole, handhole to cabinet, handhole to building, etc.)
- c. For fiber installations with joint Iowa DOT/other agency (or entity) use where the fiber will be owned by the other agency (or entity), install typical identifiers and/or markings for that fiber.

C. Method of Measurement & Basis of Payment

- 1. Measurement and payment for all fiber optic cable shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
- 2. Payment is full compensation for:
 - a. The furnishing and installation of all cables and wires per the contract documents.
 - b. Furnishing all materials, labor, tools, consumable items, and other incidental items necessary to meet the requirements of the contract documents.

2.17 Fiber Optic Cable Accessories and Hardware

A. Materials

1. Single Panel Housing (Holds One Connector Panel and Splice Organizer)

- a. Surface mounted termination/splice housings shall provide for termination capabilities, splice protection, and associated fiber/pigtail storage.
- b. Surface mount housing shall be intended for splicing and management, and cross-connect or both for up to 12 fibers.
- c. Termination adapter panels shall be duplex SC
- d. Top and bottom cable entry grommets for incoming fiber, fiber jumper.
- e. Manufactured of metal.
- f. Hinged front door, universal mounting brackets, jumper bend limiters, labels for identifying fiber terminations.
- g. Wall mountable single panel housing and adaptor panel shall be Corning, CommScope,

or Panduit (or approved equal).

2. UPC/SC Factory Terminated Fiber Connector and Pigtails (Include Splice and Connector Sleeve)

- a. All fiber connectors used on this project, including in shelves, cabinets or panels, shall be factory installed connectors.
- b. No field terminated connectors will be allowed.
- c. Connectors shall be SC/UPC having a typical insertion loss (single-mode) of 0.15 dB or less, a maximum loss of 0.35 dB or less, with typical reflectance of -55 dB, and temperature stability from -40 °C to 75 °C.
- d. Fiber used for pigtails must be of the same manufacturer as the main fiber cable.
- e. Pigtails shall be rated for the environment they are installed in.
- f. Pigtails shall be spliced in accordance with the splicing specifications and in fiber shelves or panels using manufacturer splice organizers.

3. Outside Plant (OSP) Fiber Splice Closures

- a. Supply environmental protection of cable and splices from water and dirt and that is designed to be submersed in water and installed underground outside plant use for splicing fiber optic cables in handholes.
- b. The splice closure shall be compatible with all sizes of fiber cables used on this project and large enough to accommodate the number of splices plus an additional 10% at locations where splices are shown on the plans.
- c. The closures shall be a dome type splice closure manufactured from a high density polyethylene or approved equivalent nonmetallic material with the following properties:
 - Cable entry shall be manufactured of similar material to the dome body and shall seal the closure with re-usable compressed gel cable sealing components that accommodate a wide range of cable sizes.
 - Closures shall be re-enterable and re-sealable without the need for specialized tools or equipment or any additional parts.
 - No encapsulated materials shall be allowed.
 - Be provisioned for a minimum of six cable entries.
 - Hinging splicing trays that provide controlled access to splices and slack storage.
 - Splice and storage compartments accessible via a removable dome-clamp system.
 - The closure shall allow for the storage of at least eight unopened buffer tubes.
- d. The splice closure shall contain all splice trays, storage, splice sleeves, organizing materials, and any other incidental materials required to complete the splices at the locations shown in the plans.
- e. After splicing is complete, the fiber optic cable and closure shall be flash tested for leaks.
- f. The splice closure shall be TYCO Model FOSC450 series, or approved equal.

B. Construction

1. Fusion splices shall be used to splice all continuous fiber runs in splice closures and factory terminated connector pigtails.
2. Splices shall be allowed only in the splice closures as located on the plans.
3. Maximum attenuation per splice shall be 0.02 dB when tested with the splicing equipment.
4. Splice shall provide three axis core alignment using light injection and loss measurement techniques.
5. No mechanical splices of fiber cable will be allowed.

6. All fusion splice equipment shall be factory certified within the last year. The Contractor shall provide copies of the certification 10 days prior to splicing.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all fiber optic cable accessories and hardware shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
2. Payment is full compensation for:
 - a. The furnishing and installation of all fiber optic cable accessories and hardware per the contract documents,
 - b. Furnishing materials, labor, tools, splicing equipment, consumable items, and incidentals necessary to install all required fiber accessories and hardware, access any existing splice closures, and perform quality fiber splicing and terminations to meet the requirements of the contract documents.

2.18 Locate Box

A. Materials

1. The Contractor shall provide an outdoor-rated single gang box to house communications/interconnect tracer wire.
2. The locate box shall be constructed of die-cast aluminum with a die-cast zinc weatherproof cover and self-closing lid.
3. The locate box shall be 2.75 inches by 4.5 inches by 2.625 inches deep.

B. Construction

1. The box shall be mounted to the exterior of the signal cabinet.
2. A ground wire shall be attached to a lug within the box from the signal cabinet.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all locate boxes shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
2. Payment is full compensation for:
 - a. The furnishing and installation of all locate boxes as shown in the contract documents.
 - b. Furnishing all materials, labor, equipment, and other incidental items including supply and installation of cable as necessary to meet the requirements of the contract documents.

2.19 Fiber Jumpers

A. Materials

1. General

- a. The jumpers shall be 8/125 microns single mode for operation at 1310 or 1550 nm.
- b. The jumpers shall be tight-buffered and be protected by Kevlar-type strength material.
- c. The jumpers shall be supplied with connectors on each end.
- d. Connector types (SC, LC, etc.) shall be matched to the equipment provided.
- e. Jumpers shall be sized to provide a single connection between fiber optic hardware being installed.

B. Construction

Furnish and install at locations indicated on plans or as directed by the Engineer.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all fiber jumpers shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
2. Payment is full compensation for:
 - a. The furnishing and installation of all jumpers as shown in the contract documents.
 - b. Furnishing all materials, labor, equipment, and other incidental items including supply and installation of cable as necessary to meet the requirements of the contract documents.

2.20 Gigabit Ethernet Switch System

A. Materials

1. The switch shall be industrially hardened and fully managed with an operating temperature range of -40°C to +85°C.
2. The switches shall be RuggedCom, GarrettCom, or Control (or approved equal).

B. Construction

Furnish and install at locations indicated on plans or as directed by the Engineer.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all Ethernet switch systems shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
2. Payment is full compensation for:
 - a. The furnishing and installation of all Ethernet switch systems as shown in the contract documents.
 - b. Furnishing all materials, labor, equipment, and other incidental items including supply and installation of cable as necessary to meet the requirements of the contract documents.

2.21 SFP Transceivers

A. Materials

1. The SFP shall be compatible with the Ethernet switch system SFP slot.
2. The SFP shall be rated for single-mode fiber optic cable.
3. The SFP shall be compliant with MS and IEEE 1000 Mbit standards.
4. The SFP shall use optical connections for LC fiber connector type.
5. The SFP shall communicate at 1310 nm and have a range of 10 km or 25 km (minimum, as necessary).
6. The SFP shall be rated for ambient conditions of -40°C to +85°C and relative humidity of 95%.
7. The SFP Transceivers shall be RuggedCom, GarrettCom, or Control (or approved equal).

B. Construction

Furnish and install at locations indicated on plans or as directed by the Engineer.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for all SFP Transceivers shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
2. Payment is full compensation for:
 - a. The furnishing and installation of all SFP Transceivers as shown in the contract documents.
 - b. Furnishing all materials, labor, equipment, and other incidental items including supply and installation of cable as necessary to meet the requirements of the contract documents.

**PART III
ACCEPTANCE CRITERIA**

3.01 Fiber-Optic Cable Testing

A. Materials

None.

B. Construction

1. Fiber Optic Cable Acceptance Testing

- a. Visually inspect fiber optic cable prior to installation. Report any defects to Engineer.
- b. Post installation, (100%) of the cable's fiber count shall be tested with an Optical Time Domain Reflectometer (OTDR) at 1310 nm and 1550 nm; in addition an Optical Loss Test Set (OLTS) shall be used to test the fiber. The Contractor shall provide the Engineer with up to five copies of any software required for viewing electronic files of the OLTS and OTDR traces. Use test equipment equal to EXFO FTB-500 OTDR meter, and Fluke DTX-CLT OLTS meter.
- c. All test equipment shall be factory certified within the last year. The Contractor shall provide copies of the certification 10 days prior to testing.
- d. Test results will be recorded on a form supplied by the Contractor, with data compiled in .PDF format through the meter manufacturer's software. No additional alteration using software from the Contractor beyond the meter manufacturer's software will be allowed. Prior to testing the Contractor shall submit a sample form to the Engineer. Completed test forms on each fiber shall be handed over to the Engineer. Contractor shall also provide native test (electronic version) with no alterations and meter software for viewing of fiber traces. At a minimum, test results shall show the following:
 - Cable and fiber identification (as approved by City of Sioux City)
 - Operator name
 - Date and Time
 - Setup and test parameters including wavelength, pulse width, range, scale and ambient temperature.
 - Test results for OTDR test averaged for total fiber trace, splice loss/gain (dB), connector loss (dB), all events greater than .05 dB, measured length from cable markings and total length from OTDR.
 - Test results for attenuation test including measured cable length (cable marking) total length (from OTDR test) number of splices (from as-built) and total link attenuation versus allowed attenuation.
- e. OTDR testing shall use a launch and receiving cables minimum 3281 feet or greater than the dead zone for the OTDR used for this test.
- f. Contractor shall verify prior to submittal to the Engineer that all test results satisfy the requirements of the contract documents. All test results submitted to the Engineer by the Contractor are subject to the penalties detailed below
 - All fiber optic cable is to have a maximum attenuation of 0.4 dB/km at 1310 nm and 0.3 dB/km at 1550 nm when measured bi-directionally with an OTDR. Fiber test results submitted to the Engineer that exceed the max attenuation loss specification will be identified as Out Of Specification (OOS) and shall result in penalties of \$150.00 for each OOS trace.
 - Each connector is an averaged loss value of 0.25 dB or less when measured bi-directionally with an OTDR at 1310 nm and 1550 nm. Connector test results submitted to the Engineer that exceed the max loss of 0.5 dB measured in one direction and average 0.25 dB bi-directionally specification will be identified as Out Of Specification (OOS) and shall result in penalties of \$150.00 for each OOS trace.
 - Each splice is an averaged loss value of 0.10 dB or less when measured bi-directionally with an OTDR at 1310 nm and 1550 nm. Splice test results submitted to

the Engineer that exceed the 0.10 dB or less specification will be identified as Out Of Specification (OOS) and shall result in penalties of \$150.00 for each OOS trace.

- All fiber connectors must be cleaned and checked for dirt, scratches or chips before installed in adapters and testing. All dust covers must be installed after testing is complete.
- Remove malfunctioning units, replace with new units, and retest as specified above.

2. Fiber Optic Cable Testing – Existing Fiber

The Contractor shall perform a test on the dark 288 fiber between Handhole 33-1E and Handhole 34-1E and notify the Engineer if there is damage to the cable.

C. Method of Measurement & Basis of Payment

1. Measurement and payment for fiber optic acceptance testing shall be paid for at the lump sum contract unit price bid for the pay item Traffic Signalization.
2. Payment is full compensation for:
 - a. The furnishing of all test equipment
 - b. Furnishing labor, tools, testing equipment, consumable items, and incidentals necessary to complete all acceptance testing satisfying the requirements of the contract documents.

**PART IV
ADDITIONAL BIDDING ATTACHMENTS**

4.01 Schedule of Unit Prices

IdDOT PROJECT NO. STP-A-7057(676)—86-97

Sioux City Project No. 6707-139-026

ITEM #	ITEM	UNIT	QUANTITY	UNIT COST	EXTENSION
1	CORE DRILL FOOTING	EACH	8		
2	FOOTING EXTENSION A	EACH	1		
3	FOOTING EXTENSION B	EACH	1		
4	FOOTING EXTENSION C	EACH	1		
5	3' APRON	EACH	3		
6	2" HDPE CONDUIT, BORED	LINEAR FT	45		
7	(2) 2" HDPE CONDUIT, PLOWED	LINEAR FT	7,568		
8	(2) 2" HDPE CONDUIT, BORED	LINEAR FT	8,474		
9	HANDHOLE, TYPE FOR27	EACH	18		
10	HANDHOLE, TYPE FIBER VAULT	EACH	7		
11	TRAFFIC SIGNAL CABINET	EACH	7		
12	BATTERY BACKUP SYSTEM	EACH	8		
13	CABINET MOUNTED METER	EACH	7		
14	CONNECTION TO POWER SOURCE	EACH	7		
15	TRAFFIC SIGNAL CONTROLLER	EACH	7		
16	1C #12 TRACER WIRE	LINEAR FT	16,548		
17	PULL TAPE	LINEAR FT	32,084		
18	12 SM FIBER	LINEAR FT	2,316		
19	144 SM FIBER	LINEAR FT	20,229		
20	6 DUPLEX SC CONNECTOR ADAPTOR PANEL	EACH	8		
21	SINGLE PANEL HOUSING (HOLDS 1 CONNECTOR PANEL WITH SPLICE ORGANIZER)	EACH	8		
22	UPC/SC FACTORY TERMINATED FIBER CONNECTOR AND PIGTAILS (INCLUDE SPLICE & PROTECTOR SLEEVE)	EACH	76		
23	FIBER OPTIC SPLICE CLOSURE (WITH STORAGE BASKETS)	EACH	8		
24	FIBER OPTIC 12 SPLICE TRAY	EACH	11		
25	FIBER OPTIC SPLICE (WITH PROTECTOR SLEEVES)	EACH	100		
26	FIBER OPTIC ACCEPTANCE TESTING	LUMP SUM	1		
27	FIBER OPTIC TESTING (EXISTING FIBER)	EACH	1		
28	LOCATE BOX	EACH	8		
29	GIGABIT ETHERNET SWITCH SYSTEM	EACH	8		
30	SFP TRANSCEIVERS, 1000LX, LC, 1310nm, 10 km	EACH	16		
31	SFP TRANSCEIVERS, 1000LX, LC, 1310nm, 25 km	EACH	2		
32	3 METER FIBER JUMPERS	EACH	15		
TRAFFIC SIGNALIZATION		LUMP SUM	1		

ITEM #	ITEM	UNIT	QUANTITY	UNIT COST	EXTENSION
33	REMOVE TRAFFIC SIGNAL CONTROLLER & COMPONENTS	EACH	7		
34	REMOVE CABINET	EACH	7		
35	REMOVE METER PEDESTAL	EACH	3		
36	REMOVE HANDHOLE	EACH	3		
37	REMOVE CABLE	EACH	8		
REMOVAL OF TRAFFIC SIGNALIZATION		LUMP SUM	1		

4.02 Equipment and Materials List

laDOT PROJECT NO. STP-A-7057(676)—86-97

Sioux City Project No. 6707-139-026

ITEM #	ITEM	UNIT	MANUFACTURER	CATALOG #
6	2" HDPE CONDUIT, BORED	LINEAR FT		
7	(2) 2" HDPE CONDUIT, PLOWED	LINEAR FT		
8	(2) 2" HDPE CONDUIT, BORED	LINEAR FT		
9	HANDHOLE, TYPE FOR27	EACH		
10	HANDHOLE, TYPE FIBER VAULT	EACH		
11	TRAFFIC SIGNAL CABINET	EACH		
12	BATTERY BACKUP SYSTEM	EACH		
13	CABINET MOUNTED METER	EACH		
14	CONNECTION TO POWER SOURCE	EACH		
15	TRAFFIC SIGNAL CONTROLLER	EACH		
16	1C #12 TRACER WIRE	LINEAR FT		
17	PULL TAPE	LINEAR FT		
18	12 SM FIBER	LINEAR FT		
19	144 SM FIBER	LINEAR FT		
20	6 DUPLEX SC CONNECTOR ADAPTOR PANEL	EACH		
21	SINGLE PANEL HOUSING (HOLDS 1 CONNECTOR PANEL WITH SPLICE ORGANIZER)	EACH		
22	UPC/SC FACTORY TERMINATED FIBER CONNECTOR AND PIGTAILS (INCLUDE SPLICE & PROTECTOR SLEEVE)	EACH		
23	FIBER OPTIC SPLICE CLOSURE (WITH STORAGE BASKETS)	EACH		
24	FIBER OPTIC 12 SPLICE TRAY	EACH		
25	FIBER OPTIC SPLICE (WITH PROTECTOR SLEEVES)	EACH		
28	LOCATE BOX	EACH		
29	GIGABIT ETHERNET SWITCH SYSTEM	EACH		
30	SFP TRANSCEIVERS, 1000LX, LC, 1310nm, 10 km	EACH		
31	SFP TRANSCEIVERS, 1000LX, LC, 1310nm, 25 km	EACH		
32	3 METER FIBER JUMPERS	EACH		