



# Illinois Department of Transportation

2300 South Dirksen Parkway / Springfield, Illinois / 62764

June 4, 2024

SUBJECT FAP Route 365/FAU Route 3545 (IL 56)  
Project NHPP-STP-J42U(877)  
Section 2020-265-SUR, SW&TS  
DuPage County  
Contract No. 62N32  
Item No. 231, June 14, 2024 Letting  
Addendum A

## NOTICE TO PROSPECTIVE BIDDERS:

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

1. Revised the Schedule of Prices
2. Revised page iv of the Table of Contents to the Special Provisions
3. Revised pages 154-156 of the Special Provisions
4. Added pages 330-352 to the Special Provisions
5. Revised sheets 27 & 185 of the Plans

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

Very truly yours,

A handwritten signature in black ink, appearing to read "Jack A. Elston".

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

MTS

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Revised 6/4/2024

## **LAYER II DATALINK SWITCH**

Effective: November 1, 2023

Revised: June 1, 2024

892.04TS

### Description.

This work shall consist of furnishing and installing a Layer II Ethernet switch used to transmit data from one traffic signal cabinet to another traffic signal cabinet containing a Layer II switch or a Layer III (Network) switch.

### Materials.

The Layer II switch shall be environmentally hardened with a minimum of (2) 1Gbps SFP ports and (8) 1Gbps copper RJ45 ports. Two SFP ports shall be populated with environmentally hardened optical modules capable of transmitting the designed distance on single-mode and / or multi-mode fiber optic cable as defined in the plans. An environmentally hardened power supply with input of 120 VAC and sufficient wattage for the switch shall be provided.

The switch shall conform to the following minimum specifications:

- Forwarding Bandwidth 3.8Gbps
- Switching Bandwidth 7.6Gbps
- Forwarding rate: 5.66Mpps with 64-byte packets (Line-rate at all packet sizes)
- Egress buffer: 2 MB
- Unicast MAC addresses: 8000
- Internet Group Management Protocol (IGMP) multicast groups: 255
- Virtual LANs (VLANs): 256
- IPv4 MAC security ACEs: 384 (default Ternary Content-Addressable Memory [TCAM] template)
- Bidirectional, 128 NAT translation entries
- IPv4 routing: 2000 routes, IPv6 routing: 1750 routes
- Layer 2 switching: IEEE 802.1, 802.3, 802.3at, 802.3af standard (see Table 8), VTPv2, NTP, UDLD, CDP, LLDP, Unicast MAC filter, Resilient Ethernet Protocol (REP), Media Redundancy Protocol (MRP) Ring (IEC 62439-2)
- Security: SCP, SSH, SNMPv3, TACACS+, RADIUS Server/Client, MAC Address Notification, BPDU Guard, SPAN session
- Multicast: IGMPv1, v2, v3 Snooping, IGMP filtering, IGMP Querier
- Safety certifications:
  - UL/CSA 60950-1
  - EN 60950-1
  - CB to IEC 60950-1 (with country deviations)
  - NOM to NOM-019-SCF1 (through partners and distributors)
  - CE Marking
- Hazard location:
  - ANSI/ISA 12.12.01 (Class1, Div2 A-D)
  - EN 60079-0, -15 ATEX Certificate (Class 1, Zone2 A-D)

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- EMC emissions and immunity compliance:
  - FCC 47 CFR Part 15 Class A
  - EN 55022A Class A
  - VCCI Class A
  - RoHS compliance
  - AS/NZS CISPR 22 Class A, AS/NZS CISPR 24
  - CISPR11 Class A, CISPR22 Class A
  - ICES 003 Class A
  - CE Marking
  - IEC/EN/EN61000-4-2 (Electro Static Discharge), 15kV air/8kV contact
  - IEC/EN 61000-4-3 (Radiated Immunity, 10 and 20 V/m)
  - IEC/EN 61000-4-4 (Fast Transients - 4kV power line, 4kV data line)
  - IEC/EN 61000-4-5 (Surge 2 kV/1 kV)
  - IEC/EN 61000-4-6 (Conducted Immunity, 10 V/emf)
  - IEC/EN 61000-4-8 (Power Frequency Magnetic Field Immunity)
  - IEC/EN 61000-4-9 (Pulse Magnetic Field Immunity)
  - IEC/EN 61000-4-10 (Oscillatory Magnetic Field Immunity)
  - IEC/EN 61000-4-11 (AC power Voltage Immunity)
  - IEC/EN 61000-4-29 (Voltage Dips Immunity)
  - IEC/EN 61000-6-1 (Immunity for Light Industrial Environments)
  - IEC/EN 61000-6-2 (Immunity for Industrial Environments)
  - IEC/EN 61000-6-4 Class A
  - EN 61326
- Shock and vibration:
  - IEC 60068-2-27 (Operational Shock: 30G 11ms, half sine)
  - IEC 60068-2-27 (Non-Operational Shock 55-70G, trapezoidal)
  - IEC 60068-2-6, IEC 60068-2-64, EN 61373 (Operational Vibration)
  - IEC 60068-2-6, IEC 60068-2-64, EN 61373 (Non-operational Vibration)
- Industry standards:
  - UL508
  - CSA C22.2 No. 142
  - EN 61131-2 (EMC/EMI, environmental, mechanical)
  - Substation KEMA (IEEE 1613, IEC 61850-3)
  - EN50121-3-2
  - EN50121-4
  - NEMA TS-2 (EMC, environmental, mechanical)
  - ABB Industrial IT certification
  - IP30
  - ODVA Industrial Ethernet/IP support
- Corrosive testing:
  - ISO-12944-6
  - IEC-60068-2-60
- Humidity:
  - IEC 60068-2-52 (salt fog mist, test Kb) marine environments
  - IEC 60068 -2-3
  - IEC 60068-2-30
  - Relative humidity: 5% to 95% non-condensing

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- Operating temperature:
  - -40C to +70C (vented enclosure - 40 LFM Air Flow)
  - -40C to +60C (sealed enclosure – 0 LFM Air Flow)
  - -34C to +75C (fan or blower-equipped enclosure – 200 LFM Air Flow)
  - -40C to +85C (IEC 60068-2-2 Environmental Type Testing – 16 hours)
- Operational altitude: Up to 15,000 ft
- Storage temperature:
  - -40 C to +85 C (storage temperature)
  - IEC 60068-2-14
- Storage altitude: Up to 15,000 ft
- Mean time between failure: 374,052 hours (42.7 years)
- Warranty: Five-year

The Cisco IE-3100-8T2C-E Industrial Ethernet Switch and Cisco GLC-LX-SM-RGD SFP are compliant with this specification. Other manufacturers that comply with this specification are allowed.

#### Construction Requirements

The Layer II switch and its power supply shall be mounted to either a standard DIN rail or an equipment mounting channel in the cabinet. The power supply shall be hard-wired to the cabinet power, not plugged into one of the traffic signal cabinet power outlets.

#### Configuration Design Document

A configuration design document shall be submitted within 60 days after contract award. It shall be prepared by a designer with a minimum of CCNP certification – and shall include proof of currently active CCNP credentials. The document shall contain actual configuration files for each switch to be delivered under this contract.

The Layer II switch shall be configured to be compatible with the IDOT D1 field network design. High level guidance (IP Scheme / VLANs / routing protocols, etc.) will be provided by IDOT but the integration, functionality and compatibility with the existing network are the responsibility of the contractor.

The configuration design document shall meet the acceptance of the IDOT engineer. Contractor to coordinate with IDOT Electric Maintenance Contractor and Network engineer for proper set up and IP configuration.

#### Basis of Payment

This work will be paid for at the contract unit price per each for LAYER II DATALINK SWITCH, the price of which shall include all equipment, materials, and labor required to furnish, configure and install the switch, including all necessary connectors, cables, fiber optic jumpers, hardware, software, and other peripheral equipment required to place the switch in operation to the satisfaction of the Traffic Engineer.

Revised 6/4/2024

## REMOVAL AND DISPOSAL OF REGULATED SUBSTANCES (PROJECT SPECIFIC)

**Description.** This work shall consist of the removal and disposal of regulated substances according to Section 669 of the Standard Specifications as revised below.

**Contract Specific Sites.** The excavated soil and groundwater within the areas listed below shall be managed as either “uncontaminated soil”, hazardous waste, special waste or non-special waste. For stationing, the lateral distance is measured from centerline and the farthest distance is the offset distance or construction limit, whichever is less.

**Soil Disposal Analysis.** When the waste material requires sampling for landfill disposal acceptance, the Contractor shall secure a written list of the specific analytical parameters and analytical methods required by the landfill. The Contractor shall collect and analyze the required number of samples for the parameters required by the landfill using the appropriate analytical procedures. A copy of the required parameters and analytical methods (from landfill email or on landfill letterhead) shall be provided as Attachment 4A of the BDE 2733 (Regulated Substances Final Construction Report). The price shall include all sampling materials and effort necessary for collection and management of the samples, including transportation of samples from the job site to the laboratory. The Contractor shall be responsible for determining the specific disposal facilities to be utilized; and collect and analyze any samples required for disposal facility acceptance using a NELAP certified analytical laboratory registered with the State of Illinois.

### Location 1: Intersection of Butterfield Road and IL 59, Warrenville, DuPage County, Illinois

- All excavation planned at the northwest quadrant, southwest quadrant and southeast quadrant at the intersection of Butterfield Road and IL 59. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.

### Location 2: Intersection of Butterfield Road and Batavia Road, Warrenville, DuPage County, Illinois

- All excavation planned at the northeast quadrant at the intersection of Butterfield Road and Batavia Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.
- All excavation planned at the northwest quadrant and southeast quadrant at the intersection of Butterfield Road and Batavia Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: SVOCs and Metals.

### Location 3: Intersection of Butterfield Road and Winfield Road, Warrenville, DuPage County, Illinois

- All excavation planned at the southeast quadrant at the intersection of Butterfield Road and Winfield Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Added 6/4/2024

Location 4: Intersection of Butterfield Road and Wesbrook Road / Herrick Road Wheaton, DuPage County, Illinois

- All excavation planned at the northwest quadrant at the intersection of Butterfield Road and Wesbrook Road / Herrick Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the northeast quadrant at the intersection of Butterfield Road and Wesbrook Road / Herrick Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Location 5: Intersection of Butterfield Road and Orchard Road, Wheaton, DuPage County, Illinois

- All excavation planned at the northwest quadrant and northeast quadrant at the intersection of Butterfield Road and Orchard Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Location 7: Intersection of Butterfield Road and Naperville Road, Wheaton, DuPage County, Illinois

- All excavation planned at the northwest quadrant and northeast quadrant at the intersection of Butterfield Road and Naperville Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the southwest quadrant and southeast quadrant at the intersection of Butterfield Road and Naperville Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Location 8: Intersection of Butterfield Road and East Loop Road, Wheaton, DuPage County, Illinois

- All excavation planned at the northwest quadrant at the intersection of Butterfield Road and East Loop Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: Metals.
- All excavation planned at the northeast quadrant at the intersection of Butterfield Road and East Loop Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the south quadrant at the intersection of Butterfield Road and East Loop Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.

Added 6/4/2024

Location 9: Intersection of Butterfield Road and Leask Lane, Wheaton, DuPage County, Illinois

- All excavation planned at the northwest quadrant and northeast quadrant at the intersection of Butterfield Road and Leask Lane. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the southwest quadrant at the intersection of Butterfield Road and Leask Lane. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: Metals.
- All excavation planned at the southeast quadrant at the intersection of Butterfield Road and Leask Lane. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.

Location 10: Intersection of Butterfield Road and Bradford Drive, Wheaton, DuPage County, Illinois

- All excavation planned at the northwest quadrant and northeast quadrant at the intersection of Butterfield Road and Bradford Drive. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the southwest quadrant at the intersection of Butterfield Road and Bradford Drive. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: Metals.
- All excavation planned at the southeast quadrant at the intersection of Butterfield Road and Bradford Drive. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.

Location 11: Intersection of Butterfield Road and Lambert Road/Scottsdale Circle, Glen Ellyn and Wheaton, DuPage County, Illinois

- All excavation planned at the northwest quadrant and northeast quadrant at the intersection of Butterfield Road and Lambert Road/Scottsdale Circle. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the southwest quadrant and southeast quadrant at the intersection of Butterfield Road and Lambert Road/Scottsdale Circle. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.

Location 12: Intersection of Butterfield Road and Raider Lane, Glen Ellyn, DuPage County, Illinois

- All excavation planned at the northwest quadrant and northeast quadrant at the intersection of Butterfield Road and Raider Lane. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the southwest quadrant and southeast quadrant at the intersection of Butterfield Road and Raider Lane. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.

Added 6/4/2024



Location 13: Intersection of Butterfield Road and Park Boulevard, Glen Ellyn, DuPage County, Illinois

- All excavation planned at the northwest quadrant at the intersection of Butterfield Road and Park Boulevard. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the northeast quadrant at the intersection of Butterfield Road and Park Boulevard. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the southwest quadrant at the intersection of Butterfield Road and Park Boulevard. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the southeast quadrant at the intersection of Butterfield Road and Park Boulevard. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.

Location 15: Intersection of Butterfield Road and Lloyd Avenue / Lacey Road, Lombard and Downers Grove, DuPage County, Illinois

- All excavation planned at the northeast quadrant at the intersection of Butterfield Road and Lloyd Avenue / Lacey Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs.
- All excavation planned at the southeast quadrant at the intersection of Butterfield Road and Lloyd Avenue/Lacey Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: Metals.

Location 16: Intersection of Butterfield Road and Esplanade Road, Downers Grove, DuPage County, Illinois

- All excavation planned at the northwest quadrant and northeast quadrant at the intersection of Butterfield Road and Esplanade Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the southeast quadrant at the intersection of Butterfield Road and Esplanade Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.

Location 17: Intersection of Butterfield Road and I-355 Ramp A and C, Downers Grove, DuPage County, Illinois

- All excavation planned at the northwest quadrant and northeast quadrant at the intersection of Butterfield Road and I-355 Ramp A and C. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.

Added 6/4/2024

Location 18: Intersection of Butterfield Road and I-355 Ramp B and D, Downers Grove, DuPage County, Illinois

- All excavation planned at the southwest quadrant and southeast quadrant at the intersection of Butterfield Road and I-355 Ramp B and D. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.

Location 19: Intersection of Butterfield Road and Finley Road Downers Grove, DuPage County, Illinois

- All excavation planned at the northwest quadrant and southeast quadrant at the intersection of Butterfield Road and Finley Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the southwest quadrant at the intersection of Butterfield Road and Finley Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs.
- All excavation planned at the northeast quadrant at the intersection of Butterfield Road and Finley Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.

Location 20: Intersection of Butterfield Road and Downers Drive, Downers Grove, DuPage County, Illinois

- All excavation planned at the northwest quadrant at the intersection of Butterfield Road and Downers Drive. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: Metals.
- All excavation planned at the southeast quadrant at the intersection of Butterfield Road and Downers Drive. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs.

Location 21: Intersection of Butterfield Road and Fairfield Avenue, Lombard, DuPage County, Illinois

- All excavation planned at the northwest quadrant and northeast quadrant and southwest quadrant at the intersection of Butterfield Road and Fairfield Avenue. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the southeast quadrant at the intersection of Butterfield Road and Fairfield Avenue. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.

Location 22: Intersection of Butterfield Road and Technology Drive, Lombard, DuPage County, Illinois

- All excavation planned at all four quadrants at the intersection of Butterfield Road and Technology Drive. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Added 6/4/2024

Location 23: Intersection of Butterfield Road and Fountain Square Drive, Lombard and Oak Brook, DuPage County, Illinois

- All excavation planned at the northwest quadrant at the intersection of Butterfield Road and Fountain Square Drive. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the northeast quadrant and southwest quadrant and southeast quadrant and along the southeast side of Butterfield Road, at the intersection of Butterfield Road and Fountain Square Drive. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Location 24: Intersection of Butterfield Road and Meyers Road, Lombard and Oak Brook, DuPage County, Illinois

- All excavation planned at the northwest quadrant and northeast quadrant at the intersection of Butterfield Road and Meyers Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.
- All excavation planned at the southwest quadrant at the intersection of Butterfield Road and Meyers Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the southeast quadrant and along the southeast side of Butterfield Road, at the intersection of Butterfield Road and Meyers Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Location 25: Intersection of Butterfield Road and Trans Am Plaza Drive, Oak Brook, DuPage County, Illinois

- All excavation planned at all four quadrants at the intersection of Butterfield Road and Trans Am Plaza Drive. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Location 26: Intersection of Butterfield Road and 22nd Street/Camden Court, Oak Brook and Oak Brook Terrace, DuPage County, Illinois

- All excavation planned at the northwest quadrant at the intersection of Butterfield Road and 22nd Street/Camden Court. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the northeast quadrant at the intersection of Butterfield Road and 22nd Street/Camden Court. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the southeast quadrant at the intersection of Butterfield Road and 22nd Street/Camden Court. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Added 6/4/2024

Location 27: Intersection of 22nd Street and Midwest Road Oak Brook, DuPage County, Illinois

- All excavation planned at the northwest quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.
- All excavation planned at the northeast quadrant and southwest quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Location 28: Intersection of 22nd Street and Maple Place, Oak Brook and Oak Brook Terrace, DuPage County, Illinois

- All excavation planned at all four quadrants at the intersection of 22nd Street and Maple Place. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Location 29: Intersection of 22nd Street and MacArthur Drive, Oak Brook and Oak Brook Terrace, DuPage County, Illinois

- All excavation planned at the northwest quadrant at the intersection of 22nd Street and MacArthur Drive. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the northeast quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: Metals.
- All excavation planned at the southwest quadrant and southeast quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Location 30: Intersection of 22nd Street and Parkview Drive, Oak Brook and Oak Brook Terrace, DuPage County, Illinois

- All excavation planned at the northwest quadrant and northeast quadrant at the intersection of 22nd Street and Parkview Drive. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.
- All excavation planned at the southwest quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the southeast quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Added 6/4/2024

Location 31: Intersection of 22nd Street and IL 83, Oak Brook and Oak Brook Terrace, DuPage County, Illinois

- All excavation planned at all four quadrants at the intersection of 22nd Street and IL 83. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: VOCs, SVOCs and Metals.

Location 32: Intersection of 22nd Street and Oak Brook Center West, Oak Brook, DuPage County, Illinois

- All excavation planned at the intersection of 22nd Street and Oak Brook Center West, and along the southeast side of 22<sup>nd</sup> Street. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Location 33: Intersection of 22nd Street and Oak Brook Center East, Oak Brook, DuPage County, Illinois

- All excavation planned at the northwest quadrant at the intersection of 22nd Street and Oak Brook Center East. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: Metals.
- All excavation planned at the northeast quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the southwest quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: Metals.
- All excavation planned at the southeast quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.

Location 34: Intersection of 22nd Street and Spring Road, Oak Brook, DuPage County, Illinois

- All excavation planned at the northwest quadrant at the intersection of 22nd Street and Spring Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: Metals.
- All excavation planned at the southwest quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.
- All excavation planned at the southeast quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Added 6/4/2024

Location 35: Intersection of 22nd Street and McDonald Drive, Oak Brook, DuPage County, Illinois

- All excavation planned at the northwest quadrant at the intersection of 22nd Street and McDonald Drive. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the northeast quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.
- All excavation planned at the southwest quadrant and southeast quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(5). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Location 36: Intersection of 22nd Street and Enterprise Drive / Jorie Boulevard, Oak Brook, DuPage County, Illinois

- All excavation planned at the northeast quadrant and southeast quadrant and northwest quadrant and along the northwest side of 22<sup>nd</sup> Street at the intersection of 22nd Street and Enterprise Drive/ Jorie Boulevard. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the southwest quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: SVOCs and Metals.

Location 37: Intersection of 22nd Street and York Road, Oak Brook, DuPage County, Illinois

- All excavation planned at the northwest quadrant at the intersection of 22nd Street and York Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(3). Potential contaminants of concern sampling parameters: SVOCs and Metals.
- All excavation planned at the northeast quadrant and southeast quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.
- All excavation planned at the southwest quadrant at the intersection of 22nd Street and Midwest Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(1). Potential contaminants of concern sampling parameters: SVOCs and Metals.

DMS 1: 2211 Butterfield Road, Oak Brook, DuPage County, Illinois

- All excavation planned for this location along the south side of Butterfield Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.

Added 6/4/2024

DMS 2: 1500 Butterfield Road, Oak Brook, DuPage County, Illinois

- All excavation planned for this location along the north side of Butterfield Road. The Engineer has determined this material meets the criteria of and shall be managed in accordance with Article 669.05(a)(2). Potential contaminants of concern sampling parameters: Metals.

**Work Zones**

Three distinct OSHA HAZWOPER work zones (exclusion, decontamination, and support) shall apply to projects adjacent to or within sites with documented leaking underground storage tank (LUST) incidents, or sites under management in accordance with the requirements of the Site Remediation Program (SRP), Resource Conservation and Recovery Act (RCRA), or Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), or as deemed necessary. For this project, the work zones apply for the following ISGS PESA Sites:  
**None**

**FIBER OPTIC CABLE, MICRO, SINGLE MODE**

Effective: February 1, 2018

**Description.** This work shall consist of furnishing and installing loose-tube, single-mode, fiber optic cable of the number of fibers shown in the plans and as directed by the Engineer. The cable shall be capable of being installed via jetting in a microduct conduit system.

Other ancillary components, required to complete the fiber optic cable plant, including but not limited to, moisture and water sealants, cable caps, delineator post, etc., shall be included in the cost of fiber optic cable and will not be paid for separately.

**Materials** The single-mode, fiber optic cable shall incorporate a loose, buffer-tube design. The cable shall be an accepted product of the United States Department of Agriculture Rural Utilities Service (RUS) 7 CFR 1755.900 and meet the requirements of ANSI/ICEA Standard for Fiber Optic Outside Plant Communications Cable, ANSI/ICEA S-87-640-1999 for a single sheathed, non-armored cable, and shall be new, unused and of current design and manufacture.

**Fibers.**

The cables shall use dispersion unshifted fibers. The optical and physical characteristics of the un-cabled fibers shall include:

The single-mode fiber shall meet EIA/TIA-492CAAA, "Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers," and ITU recommendation G.652.D, "Characteristics of a single-mode optical fiber cable."

Added 6/4/2024

<b>Physical Construction</b>		
<b>Requirement</b>	<b>Units</b>	<b>Value</b>
Cable Diameter	mm	8.6 (max)
Buffer Tube Diameter	mm	1.5
Colored Fiber Nominal Diameter	µm	253 – 259
Mode Field Diameter (1310 nm)	µm	9.2 ± 0.4
Mode Field Diameter (1550 nm)	µm	10.4 ± 0.5
Minimum Bending Radius (Installation)	mm	170

<b>Optical Characteristics</b>				
<b>Requirement</b>		<b>Units</b>	<b>Value</b>	
Cabled Fiber Attenuation	1310 nm	dB/km	< 0.4	
	1550 nm		< 0.3	
Point Discontinuity	1310 nm	dB	< 0.1	
	1550 nm		< 0.1	
Macrobend Attenuation	Turns	Mandrel OD	dB	
	1	32 ± 2 mm		< 0.05 at 1550 nm
	100	50 ± 2 mm		< 0.05 at 1310 nm
	100	50 ± 2 mm		< 0.10 at 1550 nm
	100	60 ± 2 mm		< 0.05 at 1550 nm
	100	60 ± 2 mm		< 0.05 at 1625 nm
Cable Cutoff Wavelength ( $X_{ccf}$ )		nm	< 1260	
Zero Dispersion Wavelength ( $X_o$ )		nm	1302 < $X_o$ < 1322	
Zero Dispersion Slope ( $S_o$ )		ps/(nm <sup>2</sup> •km)	< 0.089	
Total Dispersion	1550 nm	ps/(nm•km)	< 3.5	
	1285-1330 nm		< 17.5	
	1625 nm		< 21.5	
Cabled Polarization Mode Dispersion		ps/km <sup>-2</sup>	< 0.2	
IEEE 802.3 GbE – 1300 nm Laser Distance		m	up to 5000	
Water Peak Attenuation: 1383 ± 3 nm		dB/km	< 0.4	

### **Cable Construction.**

The number of fibers in each cable shall be as specified.

Optical fibers shall be placed inside a loose buffer tube. The nominal outer diameter of the buffer tube shall be 1.5 mm. Each buffer tube shall contain up to 12 fibers. The fibers shall not adhere to the inside of the buffer tube.

Each fiber shall be distinguishable by means of color coding in accordance with TIA/EIA-598-B, "Optical Fiber Cable Color Coding." The fibers shall be colored with ultraviolet (UV) curable inks.

Added 6/4/2024



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

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

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

Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed. Fillers shall be placed so that they do not interrupt the consecutive positioning of the buffer tubes. In dual layer cables, any fillers shall be placed in the inner layer. Fillers shall be nominally 1.5 mm in outer diameter.

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

Each buffer tube shall contain a water-swellable yarn for water-blocking protection. The water-swellable yarn shall be non-nutritive to fungus, electrically non-conductive, and homogeneous. It shall also be free from dirt or foreign matter. This yarn will preclude the need for other water-blocking material; the buffer-tube shall be gel-free. The optical fibers shall not require cleaning before placement into a splice tray or fan-out kit.

Buffer tubes shall be stranded around the dielectric central member using the reverse oscillation, or "S-Z", stranding process.

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

Tensile strength shall be provided by the central member, and additional dielectric yarns as required.

The cables shall be sheathed with medium density polyethylene (MDPE). Jacketing material shall be applied directly over the tensile strength members (as required). The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

The MDPE jacket material shall be as defined by ASTM D1248, Type II, Class C, Category 4 and Grades J4, E7 and E8.

The jacket or sheath shall be free of holes, splits, and blisters.

The cable jacket shall contain no metal elements and shall be of a consistent thickness.

Added 6/4/2024

Cable jackets shall be marked with the manufacturer's name, month and year of manufacture, sequential meter or foot markings, a telecommunication handset symbol as required by Section 350G of the National Electrical Safety Code (NESC), fiber count, and fiber type. 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 co-extruded white stripes, which shall be printed in light blue. The height of the marking shall be approximately 2.5 mm.

The maximum pulling tension shall be 1335 N (300 lbf) during installation (short term) and 400 N (90 lbf) long term installed.

The shipping, storage, and operating temperature range of the cable shall be -40°C to +70°C. The installation temperature range of the cable shall be -15°C to +60°C.

### **General Cable Performance Specifications**

The fiber optic cable manufacturer shall provide documentation and certify that the fiber optic cable complies with the following EIA-455-xxx Fiber Optic Test Procedures (FOTP):

When tested in accordance with FOTP-3, "*Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components*," the change in attenuation at extreme operational temperatures (-40°C and +70°C) shall not exceed 0.15 dB/km at 1550 nm for single-mode fiber and 0.3 dB/km at 1300 nm for multimode fiber.

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

When tested in accordance with FOTP-81, "*Compound Flow (Drip) Test for Filled Fiber Optic Cable*," the cable shall exhibit no flow (drip or leak) of filling and/or flooding material at 70°C.

When tested in accordance with FOTP-41, "*Compressive Loading Resistance of Fiber Optic Cables*," the cable shall withstand a minimum compressive load of 220 N/cm (125 lbf/in) applied uniformly over the length of the sample. The 220 N/cm (125 lbf/in) load shall be applied at a rate of 2.5 mm (0.1 in) per minute. The load shall be maintained for a period of 1 minute. The load shall then be decreased to 110 N/cm (63 lbf/in). Alternatively, it is acceptable to remove the 220 N/cm (125 lbf/in) load entirely and apply the 110 N/cm (63 lbf/in) load within five minutes at a rate of 2.5 mm (0.1 in) per minute. The 110 N/cm (63 lbf/in) load shall be maintained for a period of 10 minutes. Attenuation measurements shall be performed before release of the 110 N/cm (63 lbf/in) load. The change in attenuation shall not exceed 0.15 dB at 1550 nm for single-mode fibers and 0.30 dB at 1300 nm for multimode fiber.

When tested in accordance with FOTP-104, "*Fiber Optic Cable Cyclic Flexing Test*," the cable shall withstand 25 mechanical flexing cycles around a sheave diameter not greater than 20 times the cable diameter. The change in attenuation shall not exceed 0.15 dB at 1550 nm for single-mode fiber and 0.30 dB at 1300 nm for multimode fiber.

Added 6/4/2024

When tested in accordance with FOTP-25, "*Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies*," except that the number of cycles shall be two at three locations along a one meter cable length and the impact energy shall be atleast 4.4 Nm (in accordance with ICEA S-87-640)", the change in attenuation shall not exceed 0.15 dB at 1550 nm for single-mode fiber and 0.30 dB at 1300 nm for multimode fiber.

When tested in accordance with FOTP-33, "*Fiber Optic Cable Tensile Loading and Bending Test*," using a maximum mandrel and sheave diameter of 560 mm, the cable shall withstand a rated tensile load of 2670N (601 lbf) and residual load of 30% of the rated installation load. The axial fiber strain shall be  $\leq 60\%$  of the fiber proof level after completion of 60 minute conditioning and while the cable is under the rated installation load. The axial fiber strain shall be  $\leq 20\%$  of the fiber proof level after completion of 10 minute conditioning and while the cable is under the residual load. The change in attenuation at residual load and after load removal shall not exceed 0.15 dB at 1550 nm for single mode fiber and 0.30 dB at 1300 nm for multimode fiber.

When tested in accordance with FOTP-85, "*Fiber Optic Cable Twist Test*," a length of cable no greater than 2 meters shall withstand 10 cycles of mechanical twisting. The change in attenuation shall not exceed 0.15 dB at 1550 nm for single-mode fiber and 0.30 dB at 1300 nm for multimode fiber.

When tested in accordance with FOTP-37, "*Low or High Temperature Bend Test for Fiber Optic Cable*," the cable shall withstand four full turns around a mandrel of  $\leq 20$  times the cable diameter after conditioning for four hours at test temperatures of  $-30^{\circ}\text{C}$  and  $+60^{\circ}\text{C}$ . Neither the inner or outer surfaces of the jacket shall exhibit visible cracks, splits, tears, or other openings. The change in attenuation shall not exceed 0.30 dB at 1550 nm for single mode fiber and 0.50 dB at 1300 nm for multimode fiber.

### **Quality Assurance Provision**

All cabled optical fibers > 1000 meters in length shall be 100% attenuation tested. The attenuation of each fiber shall be provided with each cable reel. The cable manufacturer shall be TL 9000 registered.

### **Packaging**

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

Added 6/4/2024

- Cable Number
- Gross Weight
- Shipped Cable Length in Meters
- Job Order Number
- Product Number
- Customer Order Number
- Date Cable was Tested
- Manufacturer Order Number
- Cable Length Markings

a: Top (inside end of cable)

b: Bottom (outside end of cable)

The reel (one flange) marking shall include:

- Manufacturer
- Country of origin
- An arrow indicating proper direction of roll when handling
- Fork lift-handling illustration
- Handling Warnings.

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

- Manufacturer Cable Number
- Manufacturer Product Number
- Manufacturer Factory Order Number
- Customer Name
- Customer Cable Number
- Customer Purchase Order Number
- Mark for Information
- Ordered Length
- Maximum Billable Length
- Actual Shipped Length
- Measured Attenuation of Each Fiber

The cable shall be capable of withstanding a minimum-bending radius of 20 times its outer diameter during installation and 10 times its outer diameter during operation without changing the characteristics of the optical fibers.

The cable shall meet all of specified requirements under the following conditions:

- Shipping/storage temperature: -58° F to +158° F (-50° C to +70° C)
- Installation temperature: -22° F to +158° F (-30° C to +70° C)
- Operating temperature: -40° F to +158° F (-40° C to +70° C)
- Relative humidity from 0% to 95%, non-condensing

Added 6/4/2024

### **Optical Patch Cords and Pigtails.**

The optical patch cords and pigtails shall comply with the following:

- The optical patch cords shall consist of a section of single fiber, jacketed cable equipped with optical connectors at both ends.
- The factory installed connector furnished as part of the optical patch cords and pigtails shall meet or exceed the requirements for approved connectors specified herein.
- The fiber portion of each patch cord and pigtail shall be a single, jacketed fiber with optical properties identical to the optical cable furnished under this contract.
- The twelve fiber single-mode fiber optic cable shall be installed as a pigtail with factory installed **SC** compatible connectors.
- The patch cords shall comply with Telcordia GR-326-CORE

### **Connectors.**

The optical connectors shall comply with the following:

- All connectors shall be factory installed **SC** compatible connectors. Field installed connectors shall not be allowed.
- Maximum attenuation 0.4dB, typical 0.2dB.
- No more than 0.2dB increase in attenuation after 1000 insertions.
- Attenuation of all connectors will be checked and recorded at the time of installation with an insertion test minimum 5 times checked with an OTDR.
- All fibers shall be connectorized at each end.
- All fibers shall terminate at a fiber patch panel
- Unused fibers will be protected with a plastic cap to eliminate dust and moisture.
- Termination shall be facilitated by splicing factory OEM pigtails on the end of the bare fiber utilizing the fusion splicing method. Pigtails shall be one meter in length.

## **CONSTRUCTION REQUIREMENTS**

### **Experience Requirements.**

Personnel involved in the installation, splicing and testing of the fiber optic cables shall meet the following requirements:

- A minimum of three (3) years experience in the installation of fiber optic cables, including fusion splicing, terminating and testing single mode fibers.
- Install two systems where fiber optic cables are outdoors in conduit and where the systems have been in continuous satisfactory operation for at least two years. The Contractor shall submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the installed fiber optic systems.

Added 6/4/2024

- One fiber optic cable system (which may be one of the two in the preceding paragraph), which the Contractor can arrange for demonstration to the Department representatives and the Engineer.

Installers shall be familiar with the cable manufacturer's recommended procedures for installing the cable. This shall include knowledge of splicing procedures for the fusion splicer being used on this project and knowledge of all hardware such as breakout (furcation) kits and splice closures. The Contractor shall submit documented procedures to the Engineer for approval and to be used by Construction inspectors.

Personnel involved in testing shall have been trained by the manufacturer of the fiber optic cable test equipment to be used, in fiber optic cable testing procedures. Proof of this training shall be submitted to the Engineer for approval. In addition, the Contractor shall submit documentation of the testing procedures and a copy of the test equipment operation manual for approval by the Engineer.

### **Installation.**

Prior to installation, the Contractor shall provide a cable installation plan. The plan shall include the following information:

- Identify where each cable will enter the underground system and the direction each pull.
- Identify locations where the cable is pulled out of a handhole, coiled in a figure eight, and pulled back into the hand hole.
- The plan shall address the physical protection of the cable during installation and during periods of downtime.
- Identify the location of slack storage locations
- Identify the locations of splices.
- Identify distances between fiber access points and crossings.

The cable installation plan shall be provided to the Engineer for approval a minimum of 15 working days prior to the start of installation. The Engineer's approval shall be for the operation on the freeway and does not include an endorsement of the proposed procedures. The Contractor is responsible for the technical adequacy of the proposed procedures.

During cable installation operations, the Contractor shall ensure that the minimum bending of the cable is maintained during the unreeling and installation operations. Unless specified otherwise by the fiber optic cable manufacturer, the outside bend radius of the cable during installation shall be no less than 20 times the outside diameter of the fiber optic cable. Entry guide chutes shall be used to guide the cable into the handhole conduit ports. Lubricating compound may be used to minimize friction. Corner rollers (wheels), if used, shall not have radii less than the minimum installation-bending radius of the cable. A series array of smaller wheels can be used for accomplishing the bend if the cable manufacturers specifically approve the array.

Added 6/4/2024

If figure-eight techniques are used during cable installation, the cable shall be handled manually and stored on the ground. The cable shall be placed on tarps to prevent damage from gravel, rocks, or other abrasive surfaces. Tarps should also be used in muddy conditions to keep the cable clean. Enough area to accommodate the cable length to be stored and sufficient personnel to maintain the required minimum-bending diameter as well as avoid kinking or otherwise damaging the cable shall be provided. If the cable has been figure-eighted in preparation for a forward feed, the figure-eight must be flipped over to access the outside cable end. Provide sufficient personnel to avoid kinking the cable as the figure-eight is flipped over. When removing the cable from the figure-eight, use care to avoid kinking the cable and violating the minimum-bending diameter.

Power assisted or figure-eight eliminator equipment, which is used to eliminate manual figure-eight procedures, shall not be used unless specifically allowed by the cable manufacturer in writing.

The cable shall be blown or jetted into the microduct. The Contractor shall use a micro cable blowing machine designed for use with the particular cable being installed. A Compressed air cooler shall be used when ambient air temperatures reaches 68°F or more.

Where cable is to be pulled through existing conduit which contains existing cables, optical or other, the existing cables shall be removed and reinstalled with the fiber optic cable as indicated on the plans. The removal of the cable(s) shall be paid for separately. Reinstallation of the existing cables, if indicated on the plans, along with the fiber optic cable shall be included in this item for payment.

### **Construction Documentation Requirements**

#### Installation Practices for Outdoor Fiber Optic Cable Systems

The Contractor shall examine the proposed cable plant design. At least one month prior to starting installation of the fiber optic cable plant, the Contractor shall prepare and submit to the Engineer for review and approval, ten (10) copies of the Contractor's "Installation Practices for Outdoor Fiber Optic Cable Systems" manual. This manual shall address the Contractor's proposed practices covering all aspects of the fiber optic cable plant. This submittal shall include all proposed procedures, list of installation equipment, and splicing and test equipment. Test and quality control procedures shall be detailed as well as procedures for corrective action.

Added 6/4/2024

### **Operation and Maintenance Documentation**

After the fiber optic cable plant has been installed, ten (10) complete sets of Operation and Maintenance Documentation shall be provided. The documentation shall, as a minimum, include the following:

- Complete and accurate as-built diagrams showing the entire fiber optic cable plant including locations of all splices.
- Final copies of all approved test procedures
- Complete performance data of the cable plant showing the losses at each splice location and each terminal connector.
- Complete parts list including names of vendors.

### **Testing Requirements**

The Contractor shall submit detailed test procedures for approval by the Engineer. All fibers (terminated and un-terminated) shall be tested bi-directionally at both 1310 nm and 1550 nm with both an Optical Time Domain Reflectometer (OTDR) and a power meter with an optical source. For testing, intermediate breakout fibers may be concatenated and tested end-to-end. Any discrepancies between the measured results and these specifications will be resolved to the satisfaction of the Engineer.

Fibers which are not to be terminated shall be shall be tested with a temporary fusion spliced pigtail fiber. **Mechanical splice or bare fiber adapters are not acceptable.**

The Contractor shall provide the date, time and location of any tests required by this specification to the Engineer at least 5 working (7 calendar) days before performing the test. Included with the notification shall be a record drawing of the installed fiber optic cable system. The drawings shall indicate actual installed routing of the cable, the locations of splices, and locations of cable slack with slack quantities identified.

Upon completion of the cable installation, splicing, and termination, the Contractor shall test all fibers for continuity, events above 0.1 dB, and total attenuation of the cable. The test procedure shall be as follows:

A Certified Technician utilizing an Optical Time Domain Reflectometer (OTDR) and Optical Source/Power Meter shall conduct the installation test. The test equipment used shall have been calibrated within the last two years. Documentation shall be provided. The Technician is directed to conduct the test using the standard operating procedures defined by the manufacturer of the test equipment. All fibers installed shall be tested in both directions.

A fiber ring or fiber box shall be used to connect the OTDR to the fiber optic cable under test at both the launch and receive ends. The tests shall be conducted at 1310 and 1550 nm for all fibers.

Added 6/4/2024



All testing shall be witnessed by the IDOT Engineer and a copy of the test results (CD ROM or USB Drive) shall be submitted on the same day of the test. Hardcopies shall be submitted as described herein with copies on CD ROM.

At the completion of the test, the Contractor shall provide copies of the documentation of the test results to the Project Engineer. The test documentation shall be submitted as two bound copies and three CD ROM copies, and shall include the following:

**Cable & Fiber Identification:**

- Cable ID
- Cable Location - beginning and end point
- Fiber ID, including tube and fiber color
- Wavelength
- Pulse width (OTDR)
- Refractory index (OTDR)
- Operator Name
- Date & Time
- Setup Parameters
- Range (OTDR)
- Scale (OTDR)
- Setup Option chosen to pass OTDR "dead zone"

**Test Results shall include:**

- OTDR Test results
- Total Fiber Trace
- Splice Loss/Gain
- Events > 0.10 dB
- Measured Length (Cable Marking)
- Total Length (OTDR)
- Optical Source/Power Meter Total Attenuation (dB/km)

**Sample Power Meter Tabulation:**

Power Meter Measurements (dB)									
Location		Fiber No.	Cable Length (km)	A to B		B to A		Bidirectional Average	
A	B			1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm
		1							
		2							
<b>Maximum Loss</b>									
<b>Minimum Loss</b>									

The OTDR test results file format must be Bellcore/Telcordia compliant according to GR-196-CORE Issue 2, OTDR Data Standard, GR 196, Revision 1.0, GR 196, Revision 1.1, GR 196, Revision 2.0 (SR-4731) in a ".SOR" file format. A copy of the test equipment manufacturer's software to read the test files, OTDR and power, shall be provided to the Department. These results shall also be provided in tabular form, see sample below:

Added 6/4/2024

Sample OTDR Summary				
Cable Designation:	<i>TCF-IK-03</i>	OTDR Location:	<i>Pump Sta. 67</i>	<b>Date:</b> <i>1/1/00</i>
Fiber Number	Event Type	Event Location	Event Loss (dB)	
			1310 nm	1550 nm
<i>1</i>	<i>Splice</i>	<i>23500 Ft.</i>	<i>.082</i>	<i>.078</i>
<i>1</i>	<i>Splice</i>	<i>29000 Ft.</i>	<i>.075</i>	<i>.063</i>
<i>2</i>	<i>Splice</i>	<i>29000 Ft.</i>	<i>.091</i>	<i>.082</i>
<i>3</i>	<i>Splice</i>	<i>26000 Ft.</i>	<i>.072</i>	<i>.061</i>
<i>3</i>	<i>Bend</i>	<i>27000 Ft.</i>	<i>.010</i>	<i>.009</i>

The following shall be the criteria for the acceptance of the cable:

The test results shall show that the dB/km loss does not exceed +3% of the factory test or 1% of the cable's published production loss. However, no event shall exceed 0.10 dB. If any event is detected above 0.10 dB, the Contractor shall replace or repair the fiber including that event point.

The total loss of the cable (dB), less events, shall not exceed the manufacturer's production specifications as follows: 0.5 dB/km at both 1310 and 1550 nm.

If the total loss exceeds these specifications, the Contractor shall replace or repair the cable run at the no additional cost to the state, both labor and materials. Elevated attenuation due to exceeding the pulling tension, or any other installation operation, during installation shall require the replacement of the cable run at no additional cost to the State, including labor and materials.

**Splicing Requirements**

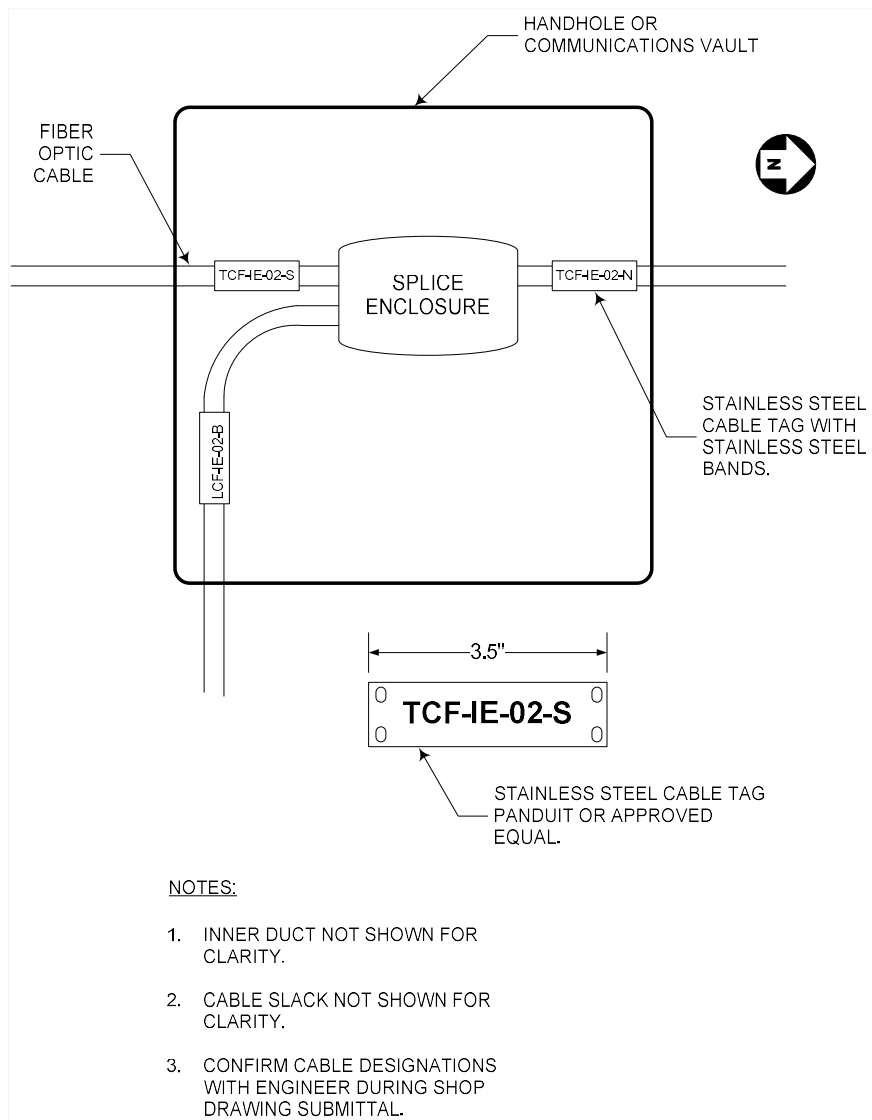
Splices shall be made at locations shown on the Plans. Any other splices shall be permitted only with the approval of the Engineer. Splices will be paid for separately. All splice locations must be identified in the Record Drawings. Cable runs which dead-end at a handhole, communications vault, interconnect cabinet, or any other type of enclosure, shall be dead ended in a splice enclosure.

**Slack Storage of Fiber Optic Cables.**

Included as a part of this item, slack fiber shall be supplied as necessary to allow splicing the fiber optic cables in a controlled environment, such as a splicing van or tent. After splicing has been completed, the slack fiber shall be stored underground in handholes or in the raised base adapters of ground mounted cabinets in accordance with the fiber optic cable manufacturer's guidelines. Fiber optic cable slack shall be 100 feet for each cable at each splice location, above or below ground. Fiber optic cable slack shall be 50 feet for each cable at access points, above or below ground, where splicing is not involved. If the innerduct is cut, the ends of the innerduct should extend beyond the first vertical rack so they can be secured at that point. This slack shall be measured for payment.

Added 6/4/2024

Fiber optic cable shall be tagged inside handholes with yellow tape containing the text: "CAUTION - FIBER OPTIC CABLE." In addition, permanent tags, as approved by the engineer, shall be attached to all cable in a hand hole or other break-out environment. These tags shall be stainless steel, nominally 0.75" by 1.72", and permanently embossed. These tags shall be attached with stainless steel straps, and shall identify the cable number, the number of fibers, and the specific fiber count. Tags and straps shall be Panduit or approved equal. See figure below:



Label the destination of each trunk cable onto the cable in each handhole, vault or cable termination panel.

Added 6/4/2024

**Method of Measurement** Fiber optic cable will be measured for payment in feet in place installed and tested. Fiber optic cable will be measured horizontally and vertically between the changes in direction, including slack cable. The entire lengths of cables installed in buildings will be measured for payment

**Basis of Payment** This work will be paid for at the contract unit price per foot for **FIBER OPTIC CABLE** of the type, size, and number of fibers specified. Payment shall not be made until the cable is installed, spliced and tested in compliance with these special provisions.

Added 6/4/2024