

SECTION 271323

COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide single-mode fiber optic cable for general telecommunication services at the buildings at the Jesse Owens State Park. Provide single mode fiber optic cable to provide connectivity between the main fire alarm control panel and the cabins' auxiliary fire alarm panels.
- B. Provide the following fiber for general telecommunications:
 - 1. (1) 60 strand OS2 fiber from the telecom vault in the Re-Veg Center, routed in the 4" conduit to cabin pedestals. The fiber shall be routed to each of the 4 communication pedestals located at the cabins.
 - 2. (1) 6 strand OS2 fiber from the pedestals to each cabin demark routed in the 2.5" conduit to cabin 10 and in the 2" conduit to cabins 1-9. Total of ten cabins.
 - 3. (1) 12 strand OS2 fiber from the telecom vault in the Re-Veg Center, routed in 4" conduit to the Check-In Building demark.
 - 4. (1) 12 strand OS2 from telecom vault in the Re-Veg Center, routed in 4" conduit to Shower House pedestal and Shower House demark.
- C. Provide the following fiber for fire alarm panel communications:
 - 1. (1) 6 strand OS2 fiber from the main fire alarm panel in the Check-In Building to the Cabin 10's auxiliary fire alarm panel. Route fiber in 4" conduit from Check-In Building, through Re-Veg Center, and continue in 4" conduit to Cabin 10's pedestal, continue from pedestal in 2.5" conduit to cabin fire alarm panel.
 - 2. (1) 6 strand OS2 fiber from each cabin fire alarm panel to the next to connect a total of 10 cabins. Route the fiber in 2" conduits from cabins to the pedestals.
- D. Provide all terminates, labeling, testing, etc. as required for a complete installation and as described below.
- E. All conduits, pedestals, innerducts in the 4" conduits, and fire alarm panels referenced above are provided by different projects and/or bid packages. Coordinate all requirements with ODNR and the appropriate contractors.
- F. Section Includes:
 - 1. Optical fiber cable connecting hardware, patch panels, and cross-connects.
 - 2. Cabling identification products.
 - 3. Single-mode, (OS2), outside plant optical fiber cable

1.2 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.

- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. RCDD: Registered Communications Distribution Designer.

1.3 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

- A. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Reviewed and stamped by RCDD.
 - 1. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 2. Cabling administration drawings and printouts.
 - 3. Wiring diagrams to show typical wiring schematics including the following:
 - a. Telecommunications rooms plans and elevations.
 - b. Telecommunications system access points.
 - c. Cross-connects.
 - d. Patch panels.
 - e. Patch cords.
 - 4. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.
- C. Optical fiber cable testing plan.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For BICSI certified RCDD, listed on the BICSI website with current credentialing, and BICSI certificates for installation technicians, installation supervisor, and field inspector qualifications. Submit copies of all certificates of staff to work on project.
- B. Installation personnel shall consist of 100% BICSI certified staff and listed on the BICSI website. There shall be at least one BICSI certified technician on site during all cable installation.
- C. The Contactor must hold a current certification from the manufacturer of the proposed connectivity solution. This certification must be valid for both installation and testing and shall enable the Contractor to offer the full manufacturer's product and applications warranties and specified. All technicians working on the project will have manufacturers training certificates.

- D. Cabling Manufacturers training certificates for each technician.
- E. The cabling testing technician shall be a Fluke Certified Cabling Test Technician, they shall perform all cable testing. Submit copies of certification.
- F. Factory calibration sheets for all testers to be used.
- G. Source quality-control reports.
- H. Product Certificates: For each type of product.
- I. Field quality-control reports.
- J. If installation staff changes during the project, the contractor shall inform the Owner Project Manager and submit updated information, including all required certificates.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For optical fiber cable, splices, and connectors to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings and cabling administration Drawings by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
 - 4. Cabling Contractor must have minimum of five years of documented experience installing structured cabling systems.
- B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI as an RCDD on staff.
 - 1. Testing Agency's Field Supervisor: Currently certified by Fluke as Certified Cabling Test Technician.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.

2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment, service suppliers, and all other trades.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. All optical fiber cabling and components shall comply with ANSI/TIA-568.3-E.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 50 or less.
- D. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- E. Grounding: Comply with TIA-607-B.

2.2 SINGLE-MODE, OUTSIDE PLANT OPTICAL FIBER CABLE (OS2)

- A. Description: Single mode, loose tube, dielectric armor, outdoor rated, 60, 12 or 6 strand fibers (or as indicated in summary), optical fiber cable. Cable shall be single-jacket, single-armored, with gel free water-blocking materials.
- B. Standards:
 1. Comply with OFNR, ANSI/ICEA S-87-640, RoHS 2011/65/EU

2. Fiber category: G.652.D
- C. Maximum Attenuation:
 1. 0.35 dB/km at 1310 nm
 2. 0.35 dB/km at 1383 nm
 3. 0.25 dB/km at 1550 nm.
- D. Jacket:
 1. Outer Jacket: Black, Polyethylene (PE)
 2. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.
 3. Corrugated steel tape armor
 4. Buffer Tube Color: Blue, Orange, Green, Brown, Grey
 5. Buffer Tube Diameter 2.5mm (0.1 in)
 6. Water-swallowable tape
 7. Fiber Coloring: blue, orange, green, brown, slate, white, red, black, yellow, violet, rose, aqua
 8. 12 fibers per tube
- E. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Corning Inc.
 - a. 60 Strand #060EUC-T4100D20
 - b. 12 Strand #012EUC-T4100D20
 - c. 6 Strand #006EUC-T4100D20
 2. Equals by Leviton-Berk-Tek or Panduit.
- F. Terminate with six strand fusion spliced pigtails or factory pre-terminated with SC/APC style connectors.
- G. Fibers shall be terminated with factory-polished UPC connectors that are manufacturer-specified for a typical insertion loss of no more than 0.2dB per connector pair and maximum allowable insertion loss of no more than 0.4dB per connector pair. Allowable materials:
 1. Factory Polished SM LC Pigtails.
 2. Factory Polished SM LC FuseLite connectors
 3. Factory pre-terminated cable
- H. Innerduct: Fabric innerduct shall be 2" – 2 cell by MaxCell MXD2002xx or Owner approved equal.

2.3 OPTICAL FIBER CABLE HARDWARE

- A. Standards:
 1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.
 2. Comply with TIA-568-C.3.
 3. Connector Type: Type SC complying with TIA-604-3-B, and Type LC complying with TIA-604-10-B connectors.

- B. Terminations at the Re-Veg Center shall be in a housing mounted in a standard 19" rack. Housing shall accommodate multiple splicing and termination modules. Installation shall include all manufacturer recommended strain relief and similar accessories.
 - 1. Housing shall be current revision of Corning CCH-1U or CCH-4U.
- C. All breakout of fibers from buffer tubes shall be within a splicing module or splicing/termination cassette. Each termination cassette shall terminate fibers in LC/UPC duplex connectors. Cassette shall be sized to terminate 12 pairs.
 - 1. The splice/termination cassette shall be Corning CCH-CS24-A9-P00RE, or CCH-CS12-A9-P00RE.
- D. Fusion spliced cassettes for termination of all fibers in Re-Veg Building Telecom Vault.
 - 1. SC/APC for single-mode fiber
 - 2. Corning #CCH-CS12-XX-XXXX or WCH-XXP
 - 3. Provide appropriately sized rack mounted, fiber housings for all splice cassettes
- E. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
 - 1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- F. Mini Wall-Mountable Building Terminal Cabinet for termination of cables in all cabins, check-in building, and shower house. Interconnect / splice housing for up to 12 single mode (OS2) fibers. LHC module type with 3-meter, ribbon pigtails, SC adapter, UPC polish, quantity as required for termination of all fibers.
 - 1. Corning #WBM12P12-3C-3RJ00
- G. Fiber Optic Splice Closure for termination in pedestals for termination and splicing of cables with in-line or butt splices. Closure shall have gasket seals for re-entry, provide separate areas for routing, protecting, and expressing buffer tubes / ribbons. Provide size required for termination of all cables. Provide all required accessories for complete installation.
 - 1. Corning #2178
- H. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.
 - 1. Provide two patch cords for every six-strands of terminated fiber
 - 2. Single-mode fiber shall be SC/APC to LC/UPC
 - 3. All path cords shall be the same manufacturer, material, and fiber type as riser cable
 - 4. Confirm all quantities and lengths with Owner prior to purchase.
- I. Plugs and Plug Assemblies:
 - 1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.
 - 2. Insertion loss not more than 0.25 dB.
 - 3. Marked to indicate transmission performance.
- J. Jacks and Jack Assemblies:
 - 1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.
 - 2. Insertion loss not more than 0.25 dB.
 - 3. Marked to indicate transmission performance.

4. Designed to snap-in to a patch panel or faceplate.

2.4 GROUNDING

- A. Comply with TIA-607-B.
- B. All fiber optic cable with metallic armor shall bonded and grounded at each end.

2.5 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- thick, vinyl flexible labels with acrylic pressure-sensitive adhesive.
 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating protective shields over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 2. Marker for Labels: Machine-printed, permanent, waterproof black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment cabinets.

2.6 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.
- C. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate service entrance cable, protectors and demarcation point with ODNR, Architect and Service Provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways except within cabinets. Conceal raceway and cables except in unfinished spaces.
- B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- C. Coordinate the installation of the fiber, enclosures, splices, etc. with all other projects and bid-packages.
- D. Terminations of fiber at the fire alarm panels shall be by the fire alarm provider. Coordinate all requirements and routing with the Owner, Architect and Cabin Contractor.

3.3 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

- A. Comply with NECA 1, NECA 301, and NECA/BICSI 568.
- B. General Requirements for Optical Fiber Cabling Installation:
 - 1. Comply with TIA-568-C.1 and TIA-568-C.3.
 - 2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
 - 3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 4. Cables may not be spliced. 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.
 - 5. Only allowable splicing shall be within the fiber termination housing for the final fusion spliced terminations.
 - 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 7. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
 - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
 11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- C. In the communications equipment vault of the Re-Veg Building, provide a 20-foot- long service loop on end of each cable, in all other buildings provide a 10-foot long service loop. Place the service loop on the wall using Leviton 49800 FR for slack management. Install cable loop in craftsmanship like manner.
- D. Optical fiber OSP cabling shall be provided for connections between campus buildings. All cables shall be outdoor rated, unless the demark is located so that the cable routing is longer than 50' inside the building. If the cable routing interior to the building is greater than 50' then the cable will be indoor / outdoor rated.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Group connecting hardware for cables into separate logical fields.
- G. When installing fiber, pair polarity shall be maintained throughout the distribution network. Each polarized (e.g. LC) termination as viewed by the user shall be "A-B" on the downstream end and "B-A" on the upstream end. Panels shall be installed and fibers terminated using the consecutive fiber method so that fiber number increases uniformly from left to right and top to bottom. I.e. on the upstream end, panels are mounted with keys up or to the right; and on the downstream end, the panels are mounted with keys down or to the left.
1. All configurations are to be reviewed and approved by the Owner prior to implementation.
- H. Outside Plant Installation:
1. (3) 1" Fabric innerduct will be provide by the site contractor in the 4" conduits. Route fiber for fire alarm panels in independent innerduct cell.
 2. Provide 2"-2 cell fabric innerduct in the 2.5" and 2" conduits routed from the cabins to the pedestals. Route the fiber for the fire alarm panels in an independent innerduct cell.
 3. Installer shall leave a neatly routed 10-20' service loop in each service entrance.
 4. Provide an additional 50'of slack storage for every 2000 feet of each cable longer than 3000 feet.
 5. No conduit may be longer than 150' or have more than 180degrees of bend, including
 6. offsets, between pull points.
 7. Conduit shall be labeled every 150' with a Fiber Caution label including notification to call 216-368-HELP before disturbing.

3.4 GROUNDING

- A. Install grounding according to BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.

- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Comply with Section 270526 "Grounding and Bonding for Communications Systems."
- D. Bond all metallic armored cables at each end.

3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B.
 - 1. All labeling requirements shall be coordinated with the Owner prior to implementation.
 - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 3 level of administration including optional identification requirements of this standard.
- C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, cables, entrance pathways and cables, terminal hardware and positions, grounding buses and pathways, and equipment grounding conductors.
- E. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables: Label each cable at intervals not exceeding 15 feet.
 - 4. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.
- F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA-606-B, for the following:
 - 1. Flexible vinyl or polyester that flexes as cables are bent.
- G. Each cable shall be labeled with:
 - 1. Quantity and type of fibers. e.g. 72 OS2.
 - 2. Location of each end of this cable. "Location / Location" where Location has one of the
 - 3. following forms:
 - a. Terminating Panel Number

- b. Terminating Splice Point identified by the man-hole number, hand-hole number, pole number, street address, pull-box number, or similar.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections by CCTT (Certified Cable Testing Technician).
- B. Testing instrument shall be Fluke Versiv #DSX-5000 or approved equal.
 - 1. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2.
 - 2. Test instrument shall be within its 12 month calibration period.
 - 3. Test instrument shall have most current software and firmware versions installed.
 - 4. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - 5. If test instruments do not meet these requirements at the time of scheduled testing, testing will not take place and will be scheduled.
- C. Tests and Inspections:
 - 1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Optical Fiber Cable Testing procedures and field test instruments shall comply with:
 - a. ANSI Z136.2, ANS for Safe Use of Optical Fiber Communications Systems Utilizing Laser Diode and LED Sources
 - b. ANSI/EIA/TIA-455-50B, Light Launch Conditions for Long-Length Graded-Index Optical Fiber Spectral Attenuation Measurements
 - c. ANSI/TIA/EIA-455-59A, Measurement of Fiber Point Discontinuities Using an OTDR
 - d. ANSI/TIA/EIA-455-60A, Measurement of Fiber or Cable Length Using an OTDR
 - 4. Adhere to all cleaning procedures during fiber testing per industry standards. Clean all connectors when mating during testing procedures.
 - 5. Verify each fiber strand for continuity with a VFL prior to light meter testing.
 - 6. Perform an end face connector test with pass/fail automated results for each strand.
 - 7. All fiber testing shall be bidirectional.
 - 8. Link End-to-End Attenuation Tests for all backbone cables, utilize light source and power meter:
 - 1) Single-mode backbone link measurements: Test at 1310 and 1550 nm according to TIA/EIA-526-7, Method A.1 and Method B for in building riser cables, and TIA/EIA-526-7, Method A.1 and Method B for outside plant cables.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.

- D. All installed cabling links and channels shall be field-tested and pass the test requirements and analysis. Any link or channel that fails these requirements shall be diagnosed and corrected. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link or channel meets performance requirements. The final and passing result of the tests for all links and channels shall be provided in the test results documentation.
- E. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- F. Remove and replace cabling where test results indicate that it does not comply with specified requirements.
- G. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- H. Prepare test and inspection reports.
- I. Acceptance of the test results shall be given in writing after the project is fully completed and the tested in accordance with the Contract Documents and to the satisfaction of the owner.

END OF SECTION 271323