SECTION 16129

FIBER OPTIC ~~CABLE AND ACCESSORIES FOR~~ DATA/~~-~~COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the contract, including General and Supplementary Conditions apply to this Section.

B. R~~ELATED~~elated S~~ECTION~~Sections: The following sections contain requirements that relate to this section:
1. Section 16111, Conduit and Fittings.
2. Section 16118, Underground Conduit Duct Bank.
3. Section 16720, Data/Communication System.
4. Section 16051, Communications Backbone Basic Materials and Methods.

~~1.2~~1.2 SUMMARY

A. This section establishes the requirements for the fiber optic~~-~~-based data/communications networks to be installed at the ~~SNS~~CNMS site. Included in the scope of this section are the product (materials), installation, and testing requirements for fiber optic networks being used for the telephone system and~~,~~ the data system~~s~~. This section covers network elements both inside facilities and in the underground ductbank system. Section 16051 has supplemental requirements for the backbone fiber optic network.

~~A.~~This section includes the following cable systems:
1. Loose tube fiber optic cable.
2. Fiber optic pig~~-~~tails.
3. Sumitomo blown fiber.

~~1.3RELATED SECTIONS The following sections contain requirements that relate to this section:~~
~~1.Section 16111, Conduit and Fittings.~~
~~2.Section 16118, Underground Conduit Duct Bank.~~
~~3.Section 16720, Data/Communication System.~~

~~1.4~~1.3 REFERENCES

~~A.~~A. National Fire Protection Association (NFPA):
~~1.~~5. NFPA 70-99, National Electrical Code, (NEC).

B. American National Standards Institute (ANSI):
1. ANSI Z136.2-88, Safe Use of Optical Fiber Communication Systems Utilizing Laser Diode and LED Sources.

C. Electronic Industries Association/Telecommunications Industry Association (EIA/TIA):
1. EIA/TIA 455-60-89 FOTP-60, Measurement of Fiber or Cable Length Using an OTDR.
2. EIA/TIA 455-61-89 FOTP-61, Measurement of Fiber or Cable Attenuation Using an OTDR.
3. EIA/TIA 526-14-A~~90~~ OFSTP-14, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.

4. EIA/TIA 492AAAA Detail Specification for 62.5 Micrometer Core Diameter/Micrometer Cladding Diameter Class 1a Graded Index Multimode Optical Fibers.
5. EIA/TIA 568-B Series ~~A12.2~~ Commercial Building Telecommunication Cabling Standard.
6. EIA/TIA 492BA00 Blank Detail Specification for class IVa Dispersion-Unshifted Single Mode Optical Waveguide Fibers.
7. EIA/TIA 526-7, Optical Power Loss Measurements of Installed Single-Mode Fiber Cable Plant.
8. EIA/TIA 455-46A, 1990, FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers.
9. EIA-455-33A, 1988, FOTP-33, Fiber Optic Cable Tensile Loading and Bending Test
10. EIA/TIA-455-30B, FOTP-29, Refractive Index Profile, Transverse Interference Method.
11. EIA/TIA-455-51A, 1991, FOTP-51, Pulse Distortion Measurement of Multimode Glass Optical Fiber Information Transmission Capacity.

D. International Electrotechnical Commission (IEC):
   1. IEC 825, Radiation Safety of Laser Products, Equipment Classification, Requirements and User's Guide.

E. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   1. IEEE 812-84, Standard Definition of Terms Relating to Fiber Optics.

~~1.5~~1.4 SUBMITTALS

A. General: Submit each item in this Section according to the conditions of the Contract and General and Supplementary Conditions.

B. Submit a QA Plan and written test procedures for approval prior to performing work.

~~B.~~C. Submit product data for information. Include with each reel of cable:
   1. Customer purchase order number.
   2. Cable part number.
   3. Weight of cable.
   4. Reel length of cable.
   5. Beginning and ending length markings.
   6. Manufacturer's certified inspection and test report.

~~C.~~D. Submit product data for information. Include with fiber optic pigtails:
   1. Customer purchase order number.
   2. Cable part number.
   3. Length of pigtails.
   4. Manufacturer's certified inspection and test report.

~~D.~~E. Submit field test reports for approval.

F. Submit factory calibration certification of all test equipment used.

G. Submit contractor, installer and testing agency qualification records and certifications.

A.1.5 QUALITY ASSURANCE

A. EIA/TIA Compliance: Fibers/Cables shall be designed, fabricated, and installed in compliance with applicable EIA/TIA standards.

B. UL Cables Compliance: Provide cables that are listed and labeled by UL.

C. Comply with NFPA 70 for electrical components, devices, and accessories installation.

D. Coordination: Coordinate layout and installation of cables with other installations.

E. All fiber optic cabling shall be tested by a qualified independent testing agency engaged by the contractor. The independent testing agency shall subject all fiber optic cabling to visual and mechanical inspection field tests, including procedures stated in TIA/EIA Standards. Contractor must certify that test parameters comply with manufacturer's written instructions and Specification 16129.

F. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:

- the manufacturer of the fiber optic cable and/or the fiber optic connectors
- the manufacturer of the test equipment used for the field certification
- training organizations authorized by BICSI (Building Industry Consulting Services International) or the NJATC (National Joint Apprenticeship Training Committee).

1.71.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials with protective crating and covering on reels.

B. Lift and support reels with manufacturer's designated lifting or supporting points.

1.81.7 SEQUENCING AND SCHEDULING

A. Coordinate cable installation with duct and tray installation.

B. Coordinate location of termination points with room and equipment installations.

PART 2 - PRODUCTS

1.92.1 ACCEPTABLE MANUFACTURERS

A. Corning Siecor Corporation
489 Siecor Park
Hickory, NC 28603-0489
1-800-634-9064

B. AT&T Network Systems (Lucent)
2000 Northeast Expressway
Norcross, GA 30071
1-800-344-0223

B. CommScope
1375 Lenoir-Rhyne Boulevard
Hickory, NC 28603-1729
1-800-544-1948

C. Belden Wire and Cable
2175 Parklake Drive, Suite 120
Atlanta, GA 30345
1-404-934-6767

D. Sumitomo Electric Lightwave Corp.
78 Alexander Drive
Research Triangle Park, NC 27709
1-800-358-7378

~~1.10~~2.2 LOOSE TUBE FIBER OPTIC CABLE

A. General:
1. 100% all-dielectric, loose tube fiber optic cable suitable for use in both tray and duct applications.
2. Glass optical core fiber with a core cladding of low density glass concentric about the optical core and a protective acrylate buffer coating to protect the outer surface of the fiber.
3. Core assembly: Single layer of loose tubes stranded around an all-dielectric, antibuckling, central member, wrapped with a binder tape to maintain the alignment of the buffer tubes. Tensile strength member: Aramid fiber applied over the binder tape followed by an outer jacket of black polyethylene of medium or high density (MDPE or HDPE).
4. ~~Fill interstices in the cable core with~~Cable core to contain a water-blocking compound to prevent water penetration and migration. ~~Filling~~Water blocking compound: electrically nonconductive, homogeneous and free from dirt and other foreign matter.
5. Provide a continuous dielectric rip cord under the outer jacket to permit jacket removal without damage to the optical fibers.
6. Enclose individual fibers in color coded plastic buffer tubes.
7. Contain ~~no more than six (6)~~ up to twelve (12) multimode fibers or ~~six (6)~~ twelve (12) single-mode fibers in an individual buffer tube. Color-code buffer tubes and individual fibers within a buffer tube as follows: Blue, Orange, Green, Brown, Slate, White, Red, Black, Yellow, Violet, Rose, Aqua. ~~Contain single-mode fibers in the blue color-coded buffer tube.~~Single-mode fibers to be contained in the first active tubes.
8. Ship cable on reels from the manufacturer in continuous lengths with no splices in the cable.
9. Cladding outside diameter: 125 ± 1.0 micron.
10. Cladding noncircularity: ± 2 %.
11. Concentricity error: < 6 %.
12. Protective coating diameter: 250 ± 15 microns.
13. ~~Flame~~Where required, flame retardant properties of cable shall meet the requirements of NFPA 70, NEC, Article 770-53(e).

B. Multimode Optical Fiber:
1. Fiber Type: Class 1a graded-index, dual window, multimode fiber, compliant with ANSI/TIA/EIA-492 AAAA.
2. Core Diameter: 62.5 ± 3.0 microns.
3. Core Noncircularity: < 6.0 %.

4. Numerical Aperture: 0.27 - 0.29.
5. Maximum Attenuation: 3.5 dB/km @ 850 nm, 1.5 dB/km @ 1300 nm.
6. Minimum Bandwidth: 160 MHz-km @ 850 nm, 500 MHz-km @ 1300 nm.
7. Gigabit ethernet distance guarantee: 850 nm-300 meters, 1,300 nm-550 meters.

C. Single-Mode Optical Fiber:
1. Fiber Type: Class IVa dispersion unshifted single-mode fiber, compliant with ANSI/TIA/EIA-492BAAA
2. Core Diameter: 8.3 microns (nominal).
3. Mode Field Diameter: 8.7 - 9.5 microns.
4. Cable Cut-off Wavelength: < 1250 nm.
5. Maximum Attenuation: 0.4 dB/km @ 1310 nm, 0.3 dB/km @ 1550 nm.
6. Zero Dispersion Wavelength: 1300 - 1322 nm.
7. Zero Dispersion Slope: < 0.095 ps/(nm^2-km).
8. Gigabit ethernet distance guarantee: 1,310/1,550 nm-5,000 meters.

D. Cable Mechanical Specifications:
1. Nominal Jacket Wall Thickness: 0.055 in.
2. Maximum Tensile Load Rating - Installation: > 600 lbs.
3. Maximum Tensile Load Rating - Maintained: > 100 lbs.
4. Minimum Bending Radius - Installation: < 20 x Cable OD.
5. Minimum Bending Radius - Maintained: < 12 x Cable OD.

E. Maximum attenuation variation during operation (-40 deg C to +65 deg C), installation (-30 deg C to +60 deg C), and storage (-50 deg C to +70 deg C):
1. Multimode fibers: ± 0.50 dB/km at 1300 nm.
2. Single-mode fibers: ± 0.20 dB/km at 1550 nm.

F. Cable Markings:
1. Imprinted with white characters on the outer cable jacket.
2. Permanent, insoluble in water and legible for the cable life.
3. Imprint the following identification markings on the cable jacket at intervals of not more than one meter:
   a. Manufacturer
   b. Year of manufacture
   c. "OPTICAL CABLE"
   d. Manufacturer's part number
4. Imprint sequentially numbered feet or meter length markings on the jacket within +1, -0% of actual length without resetting the length markings to zero on the cable.

G. Provide approximately two (2) meters of accessible cable on the inboard end of each cable for optical time domain reflectometer (OTDR) testing of the cable.

~~1.11~~2.~~34~~ MULTIMODE FIBER OPTIC PIGTAIL

~~A.~~A. General:
~~1.~~1. Pre-connectorized multimode fiber optic pigtail suitable for splicing outside plant (OSP) fibers to termination equipment.
~~2.~~2. Glass optical core fiber with a core cladding of low density glass concentric about the optical core, a protective acrylate buffer coating, and a PVC loose tube buffer to protect the outer surface of the fiber.
~~3.Tensile strength member: Aramid fiber applied over the buffered fiber followed by a PVC outer jacket.~~
~~4.~~3 Factory-terminated on one end with a SC-type fiber optic connector.

5. Field determine each pigtail length with minimum 6 feet.

~~B.~~B Optical Fiber Specifications:
~~1.~~1. Buffer Diameter: 900 microns.
~~2.~~2. Maximum Connector Insertion Loss: 0.5 dB.
~~3.~~3. Connector Return Loss: < -55 dB.
~~4.~~4. All specifications listed in 16129.

~~C.~~C Pigtail Mechanical Specifications:
~~1.~~1. Nominal Cable Diameter: 0.12 in.
~~2.~~2. Maximum Tensile Load Rating - Installation: > 100 lbs.
~~3.~~3. Maximum Tensile Load Rating - Maintained: > 50 lbs.
~~4.~~4. Minimum Bending Radius - Installation: < 2.0 in.
~~5.~~5. Minimum Bending Radius - Maintained: < 1.5 in.
6. Crush Resistance: > 400 lbs./in.
7. Impact Resistance: > 1,000 cycles.
8. Flex Resistance: > 7,500 cycles.
9. Cable Length: 6.0 ft (minimum), or as determined by installation contractor and approved by Construction Manager.

~~D.~~D. Maximum attenuation variation of ± 0.50 dB/km at 1300 nm during operation (-40 deg C to +65 deg C), installation (-30 deg C to +60 deg C), and storage (-50 deg C to +70 deg C):

~~E.~~E. Pigtail Termination:
~~1.~~1. One end of the fiber optic pigtail factory-terminated with a SC-style connector with a strain relief boot with no terminations on the other end.
~~2.~~2. Ferrule Material: Zirconia Ceramic.
~~3.~~3. Connector color shall be beige.

~~1.12~~2.4 SINGLEMODE FIBER OPTIC PIGTAIL

A. General
1. Pre-connectorized singlemode fiber optic pigtail suitable for splicing outside plant (OSP) fibers to termination equipment.
2. Glass optical core fiber with a core cladding of low density glass concentric about the optical core, a protective acrylate buffer coating, and a PVC loose tube buffer to protect the outer surface of the fiber.
~~3. Tensile strength member: Aramid fiber applied over the buffered fiber followed by a PVC outer jacket.~~
~~4.~~3. Factory-terminated on one end with a SC-type fiber optic connector.
~~5.~~4. Field determine each pigtail length minimum 6 foot.

B. Optical Fiber Specifications
1. Buffer Diameter: 900 microns.
2. Maximum Connector Insertion Loss: 0.5 dB.
3. Connector Return Loss: < -55 dB.
4. All specifications listed in 16129

C. Pigtail Mechanical Specifications
1. Nominal Cable Diameter: 0.12 in.
2. Maximum Tensile Load Rating - Installation: > 100 lbs.
3. Maximum Tensile Load Rating - Maintained: > 50 lbs.
4. Minimum Bending Radius - Installation: < 2.0 in.
5. Minimum Bending Radius - Maintained: < 1.5 in.

6. Crush Resistance: > 400 lbs./in.
7. Impact Resistance: > 1,000 cycles.
8. Flex Resistance: > 7,500 cycles.
9. Cable Length : 6.0 ft (minimum), or as determined by installation contractor and approved by the Construction Manager

D. Maximum attenuation variation of + 0.01 dB/km at 1300 nm during operation (-40 deg C to +65 deg C), installation (-30 deg C to +60 deg C), and storage (-50 deg C to +70 deg C):

E. Pigtail Termination
1. One end of the fiber optic pigtail factory-terminated with a SC-style connector with a strain relief boot with no terminations on the other end.
2. Ferrule Material: Zirconia Ceramic.
3. Connector color shall be blue.

~~2.5~~2.5 SOURCE QUALITY CONTROL

~~A.~~A. Inspect and test fiber optic cables and pigtails at the manufacturer's plant to show full compliance with the optical and mechanical requirements listed above.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that existing conduit is suitable for use.

B. Verify that tray system is suitable for use.

C. Verify that termination points are ready for connections.

3.2 INSTALLATION

A. Install cable after interior of buildings have been physically protected from weather and all mechanical work likely to injure cables has been completed.

B. Install multi-colored innerduct in conduit and tray where indicated.

C. Install wall mounted fiber optic cable pull boxes where indicated.

D. Install fiber optic cables in innerduct in accordance with manufacturer's installation instructions.

E. Before installing cabling, ensure all cable pathways are completely and thoroughly cleaned:
1. Inspect conduit, wireway, cable trays, and innerduct installed by others.
2. Swab any additional enclosed raceway and innerduct systems furnished.

F. Pulltape
1. Pulltape (muletape) with preprinted foot markers. Provide pulltape in each empty communications conduit containing a bend or over 10 feet in length.
2. Use provided pull tapes to install cable.

G. Install communications cable in accordance with manufacturer’s instructions so as not to exceed the manufacturer’s specified pulling tension.

H. Provide pigtails of adequate length for neat, trained, and bundled connections.

I. Provide protection for exposed cables where subject to damage.
   1. Provide abrasion protection for any cable or wire bundles which pass through holes or across edges of sheet metal.
   2. When installing cable, insure that any lengths of cable dressed along the floor are protected from traffic.

J. Cabling: Utilize continuous unspliced lengths of fiber optic strands between splice enclosures and/or termination points.
   1. Arrange cable neatly, cut to proper length, and remove surplus strand.
   2. Provide suitable cable slack in vaults, handholes, boxes, outlets, and at turns to ensure that there is no kinking or binding of the sheath.
   3. Where possible, route cables in overhead cable trays and inside wire management systems attached to the equipment cabinets and racks. Use plastic ties or ducts to restrain cabling installed outside of wire management systems on racks or in cabinets.
   4. The number of fiber strands specified for each cable shall be terminated and working.

K. Place fiber optic cable so as to maintain the minimum cable bend radius limits specified by the manufacturer or ten times the cable diameter, whichever is larger.

L. Use care when handling fiber optic cable. Carefully monitor pulling tension so as not to exceed the limits specified by the manufacturer.

M. Install fiber optic cables in innerduct where noted on the drawings or cable schedules.
   1. Keep backbone fiber optic cables separate from Unshielded Twisted Pair (UTP) and other cables in the communications room cable trays.
   2. Provide split corrugated innerduct and/or plastic wiring duct to protect fiber optic cables at transitions from cable tray systems to equipment cabinets and racks.

N. Splicing: There shall be no splicing of ~~intrabuilding~~ fiber optic cable~~. All fiber optic splices require~~ without prior review by the Construction Manager.

O. Multi-Mode Optical Fiber Termination:
   1. Multi-mode optical fiber termination shall be a fusion splice to multi-mode pigtail described here-in.

P. Single-Mode Optical Fiber Termination:
   1. Single-mode optical fiber termination shall be a fusion splice to single mode pigtail described here-in.

Q. Manufacturer's installation guidelines must be met to obtain manufacturer warranty.

3.3 FIELD QUALITY CONTROL

A. Meet or exceed all performance requirements specified when operated under the following environmental conditions without auxiliary heating, cooling, or dehumidification and without additional adjustments unless otherwise noted.
   1. Ambient Temperature Range: -40 deg C to 65 deg C.
   2. Humidity Range: 10% to 100%

B. Maximum Fiber Attenuation ~~(Per EIA 455-46 or 455-61 as applicable):~~

1. Multimode:
   A. 3.5 dB/km at 850 nm.
   B. 1.5 dB/km at 1,300 nm.
   C. Maximum Fusion Splice Loss: 0.1~~3~~ dB.
   D. Maximum Connector Loss: 0.5 dB (connector loss is defined as the total optical power loss through a mated pair of connectors).

2. Singlemode:
   A. 0.4 dB/km at 850 nm.
   B. 0.3 dB/km at 1,300 nm.
   C. Maximum Fusion Splice Loss: 0.1~~3~~ dB.
   D. Maximum Connector Loss: 0.5 dB (connector loss is defined as the total optical power loss through a mated pair of connectors).

C. Band width: Comply with EIA 455-30A or EIA 455-51 (as applicable).

D. Physical Testing:
   1. Tensile strength and bending radius: EIA 455- 33A

E. Color coding: EIA 455A

F. Performance Testing:

1. Before Installation: Use an OTDR to test the fiber optic cable after it is delivered to the site and while it is still on the reel. Test each fiber in each reel of cable at the 1,300 nm wavelength. Provide a hardcopy and electronic copy of the OTDR trace as part of the overall testing documentation showing the placement of measurement cursors, measured fiber length, measured attenuation (dB/km), operating wavelength, cable reel number, and the specific fiber in the cable being tested.

2. After Installation/Unterminated Fibers: After cable installation but before pigtails are spliced to the fibers from the trunk cable, perform an OTDR test on each installed length of cable to insure no damage was done to the fibers during installation. Perform the test on each fiber in each buffer tube. OTDR traces of these tests are not required.

3. After Installation/Terminated Fibers: After the pigtails are spliced to the trunk cable fibers, perform an OTDR test for each completed fiber optic link testing every fiber in each cable, including spares. Test each fiber in both directions at both wavelengths. Provide a hardcopy and electronic copy of the OTDR traces as part of the overall testing documentation. Show on the OTDR trace the placement of measurement cursors, measured fiber length, measured attenuation (dB/km), operating wavelength, cable identification number, and the specific fiber in the cable being tested.

   ~~Final OTDR test shall be performed after installation is complete.~~
   ~~Measurement of fiber or cable length using an OTDR: EIA/TIA 455-60-89 FOTP-60~~
   a. ~~Measurement of fiber or cable attenuation using an OTDR: EIA/TIA 455-61-89 FOTP-61~~

4. End-to-End Attenuation Test: Perform insertion loss tests conforming to EIA/TIA Standard 526-14 (Method B) for multimode and EIA/TIA standard 526-7 (Method 1) for single mode, for each installed fiber optic link (i.e., after the pigtails are

spliced to the trunk cable fibers). Test multimode fibers with an LED source at the 850 nm and 1,300 nm wavelengths. Test single-mode fibers with a laser source at 1,310 nm and 1,550 nm. Minimize the effects of modal distribution on connector and fiber loss. Use launch and receive cables three (3) meters in length which match the fiber type being tested to connect the test instrumentation to the fiber link. Replace all dust caps after testing is completed.

Test Procedure is as follows:

a. Attach one end of the launch cable to the source and the other end to the fiber optic power meter. Adjust the source power to a convenient value such as 0 dBu (-30 dBm); this is the reference power level (P_{ref}).
b. Disconnect the launch cable from the power meter and reconnect it to a test connector coupling. Do not disconnect the launch cable from the source after recording P_{ref}. Connect one end of the receive cable to the other side of the test connector coupling and attach the other end to the fiber optic power meter. Verify that the attenuation added by the receive cable is not greater than 0.5 dB.
c. Remove the test connector coupling. Attach the launch cable to the fiber link to be tested by connecting it to the appropriate connector coupling in the local distribution frame. Attach the receive cable to the opposite end of the fiber link under test by connecting it to the appropriate connector coupling in the remote distribution frame. Record the measured link loss (i.e. the measured power level, P_{test}, minus P_{ref}, in dB) on the accompanying form (Attachment B).
d. Compare the measured values to the calculated losses specified. If a fiber fails to meet these specifications, clean the connectors, inspect with a microscope, and retest. If the fiber still fails the insertion loss test, perform an OTDR test to determine the necessary corrective action.

5. Prepare the “Link Loss Certification Test Report – Attachment B”. Record the calculated link loss. The measured link loss must not exceed the calculated link loss at the 850 nm and 1,300 nm windows for multimode and at the 1,310 nm and 1,550 nm windows for single-mode fiber. Calculations used for certification purposes will use fiber lengths as determined by the OTDR test for the power meter and light source measurements.

   Link attenuation shall be calculated by the following formulas specified in ANSI/TIA/EIA Standard 568-B.

   Link Attenuation = Cable Attn + Connector Attn + Splice Attn
   Cable Attn (dB) = Attenuation Coefficient (dB/km) + Length (Km)

   The values for the Attenuation Coefficient are listed in the table below:

Type of Optical Fiber	**Wavelength (nm)**	**Attenuation Coefficient (dB/km)**
Multimode 62.5/125 µm	850	3.5
	1300	1.5
Singlemode	1310	.4
	1550	.3

   Connector Attn (dB) = number of connector pairs x connector loss (dB)
   Maximum allowable connector loss = .5 dB
   Splice Attn dB) = number of splices (S) x splice loss (dB)

Maximum allow fusion splice loss = 0.1 dB

G. Provide all test equipment, including the Optical Time Domain Reflectometer (OTDR), power meters, LED sources, laser sources, connector adapters, launch and receive cables, attenuators, and other devices necessary testing. Use a high-resolution OTDR for providing signature traces. Factory calibrated test equipment shall be used. The test equipment shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.

H. Maintain and format test documentation in accordance with ANSI/TIA/EIA-606 "Administration Standard for the Telecommunications Infrastructures of Commercial Buildings". Test documentation will consist of signature trace and event table for each fiber. Provide hardcopy and electronic of the test data as part of the overall test documentation. If proprietary software is used, contractor shall provide any necessary software required to view test results. Electronic reports must be accompanied by a certificate signed by an authorized representative of the cabling contractor warranting the truth and accuracy of the electronic reports. Certificate must reference traceable circuit numbers that match the electronic record.

I. Provide the electronic data of splice loss values from the fusion splicer for each pigtail splice.

J. Prepare a separate Fiber Optic Test Report (Attachment A) for each type of test performed (i.e. before installation OTDR test, after installation/before splicing OTDR test, after splicing OTDR test, and insertion loss test). Refer to Attachment B for the insertion loss test report (Link Loss Certification Test Report). Assemble test reports and OTDR traces, including electronic traces, in a complete bound manual. Submit manual to Construction Manager for approval. ~~, information and records.~~

ATTACHMENT A

FIBER OPTIC TEST REPORT

Project Title: _____ Page ___ of ___

ESO (W.O.): _____

Date: _____

Type of Test: _____

Section of 16129 Defining Test: _____

Test Instrument: _____

Model No: _____ Serial No: _____ Calibration Date: _____

Test Instrument: _____

Model No: _____ Serial No: _____ Calibration Date: _____

Source (Type): _____ Wavelength: _____

Model No: _____ Serial No: _____ Calibration Date: _____

Source (Type): _____ Wavelength: _____

Model No: _____ Serial No: _____ Calibration Date: _____

Source (Type): _____ Wavelength: _____

Model No: _____ Serial No: _____ Calibration Date: _____

Test Performed By: _____ Organization: _____

Test Supervised By: _____ Organization: _____

Test Witnessed By: _____ Organization: _____

Construction Engineer: _____

Telecommunications Representative: _____

ATTACHMENT B
LINK LOSS CERTIFICATION TEST REPORT

Project: _____ ESO (W.O.): _____
TEST PERFORMED BY: _____ DATE: _____
TEST WITNESSED BY: _____

PAGE _____ OF _____

CABLE NO: _____
FROM (TRANSMIT): _____
TO (RECEIVE): _____ PASS FAIL
CABLE LENGTH: _____
LENGTH OF LAUNCH CABLE: _____

		Calculated Loss Value		Measured Loss Value		Difference	
FIBER NO.	INDICATE TYPE: (MM/SM)	850-nm/ 1,310 nm	1,300 nm/ 1,550 nm	850 nm/ 1,310 nm	1,300 nm/ 1,550 nm	850 nm/ 1,310 nm	1,300 nm/ 1,550 nm

END OF SECTION 16129