JOINT BASE LEWIS-MCCHORD DESIGN STANDARDS

DIVISION 33 – UTILITIES

SECTION 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP)

05/25

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B1 (2013) Standard Specification for Hard-Drawn Copper Wire

ASTM B8 (2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ASTM D1557 (2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kNm/m3)

ASTM D709 (2017) Standard Specification for Laminated Thermosetting Materials

BICSI, Information Technology Systems Installation Methods Manual

BICSI, Outside Plant Design Reference Manual

BICSI, Telecommunications Distribution Methods Manual

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

IEEE C2 (2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

INSULATED CABLE ENGINEERS' ASSOCIATION (ICEA)

ICEA S-87-640 (2016) Optical Fiber Outside Plant Communications Cable; 4th Edition

ICEA S-98-688 (2012) Broadband Twisted Pair Telecommunication Cable, Aircore, Polyolefin Insulated, Copper Conductors Technical Requirements

ICEA S-99-689 (2012) Broadband Twisted Pair Telecommunication Cable Filled, Polyolefin Insulated, Copper Conductors Technical Requirements

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C62.61 (1993) American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; SECTION 33 82 00 Page 6 TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10, TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14) National Electrical Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-455-107 (1999a) FOTP-107 Determination of Component Reflectance or Link/System Return Loss using a Loss Test Set

TIA-455-46A (1990) FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers

TIA-455-78-B (2002) FOTP-78 Optical Fibers - Part 1-40: Measurement Methods and Test Procedures - Attenuation

TIA-472D000 (2007b) Fiber Optic Communications Cable for Outside Plant Use

TIA-492AAAA (2009b) 62.5-um Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers

TIA-492AAAB (2009a) 50-Um Core Diameter/125-Um Cladding Diameter Class IA Graded-Index Multimode Optical Fibers

TIA-492CAAA (1998; R 2002) Detail Specification for Class IVa DispersionUnshifted Single-Mode Optical Fibers

TIA-492E000 (1996; R 2002) Sectional Specification for Class IVd NonzeroDispersion Single-Mode Optical Fibers for the 1550 nm Window

TIA-526-14 (2015c) OFSTP-14A Optical Power Loss Measurements of Installed

Multimode Fiber Cable Plant

TIA-526-7 (2015a) OFSTP-7 Measurement of Optical Power Loss of Installed

Single-Mode Fiber Cable Plant

TIA-568-C.1 (2009; Add 2 2011; Add 1 2012) Commercial building

Telecommunications Cabling Standard

TIA-568-C.2 (2009; Errata 2010; Add 2 2014; Add 1 2016) Balanced Twisted-Pair

Telecommunications Cabling and Components Standards

TIA-568-C.3 (2008; Add 1 2011) Optical Fiber Cabling SECTION 33 82 00 Page 7

Components Standard

TIA-569 (2015d) Telecommunications Pathways and Spaces

TIA-590 (1997a) Standard for Physical Location and Protection of Below Ground

Fiber Optic Cable Plant

TIA-606 (2017c) Administration Standard for the Telecommunications

Infrastructure

TIA-607 (2013b) Generic Telecommunications Bonding and Grounding (Earthing)

for Customer Premises

TIA-758 (2012b) Customer-Owned Outside Plant Telecommunications Infrastructure

Standard

TIA/EIA-455 (1998b) Standard Test Procedure for Fiber Optic Fibers, Cables,

Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber

Optic Components

TIA/EIA-455-204 (2000) Standard for Measurement of Bandwidth on Multimode

Fiber

TIA/EIA-598 (2014D; Add 2 2018) Optical Fiber Cable Color Coding

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS 1755 Telecommunications Standards and Specifications for Materials,

Equipment and Construction

RUS Bull 1751F-630 (1996) Design of Aerial Plant

RUS Bull 1751F-640 (1995) Design of Buried Plant, Physical Considerations

RUS Bull 1751F-643 (2002) Underground Plant Design

RUS Bull 1751F-815 (1979) Electrical Protection of Outside Plant

RUS Bull 1753F-201 (1997) Acceptance Tests of Telecommunications Plant (PC-4)

RUS Bull 1753F-401 (1995) Splicing Copper and Fiber Optic Cables (PC-2)

RUS Bull 345-50 (1979) Trunk Carrier Systems (PE-60)

RUS Bull 345-65 (1985) Shield Bonding Connectors (PE-65)

RUS Bull 345-72 (1985) Filled Splice Closures (PE-74)

RUS Bull 345-83 (1979; Rev Oct 1982) Gas Tube Surge Arrestors (PE-80)

UNDERWRITERS LABORATORIES (UL)

UL 497 (2001; Reprint Jul 2013) Protectors for Paired Conductor Communication

Circuits

UL 510 (2017) UL Standard for Safety Polyvinyl Chloride, Polyethylene and

Rubber Insulating Tape

UL 83 (2017) UL Standard for Safety Thermoplastic-Insulated Wires and Cables

UFC 3-580-01 (21 November 2024), Information and Communications Technology Infrastructure Planning and Design

1.1.1 Site Telecommunication

1.1 General: Government Telecommunications systems (voice/data) consist of the Army-owned telephone system Voice over Internet Protocol ***(VOIP),*** which provides Army communications, and the Local Area Network (LAN). Install outside plant

telecommunications maintenance holes/vaults/hand holes, ducts/conduits, and required distribution cables between identified point of connection and the building's telecommunications entrance facility. Coordinate all telecommunication requirements with the USACE PE/QA; Telecommunications Contractor and their Registered Communications Distribution Designer (RCDD) on staff and at site; and JBLM Network Enterprise Center (NEC), specifically with the Plans Branch and the MCA IT Project Manager and Team Members, through the Contracting Officer. Coordinate and attend inspections with DPW/NEC during each phase of construction. Non-Army Communications for residential telephone, cable television, and internet access is furnished by local commercial communications carriers.

1.1.1 Coordination with Adjacent Construction Projects: Alert the Contracting Officer when coordination with adjacent construction projects is required by the Telecommunications System Contractor. The RCDD on staff and at site shall be included in all telecommunication coordination activities.

1.1.2 Telecommunication Drawings

Follow the TIA-606 and JBLM NEC Telecommunications Drawing Template. Standard telecommunication drawings are:

T0 – Campus or site plans – exterior pathways and campus cabling.

T1 – Layout of complete building per floor – building area/serving zone boundaries, Cabling Subsystem 1, 2, and 3 pathways.

T2 – Serving zones/building area drawings – drop locations and cable ID's. T2 drawings show a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas (examples of a T2 drawing level is shown in figure 32 with examples of T2 symbols are shown in figure 28, and T2 general pathway conditions are listed in figure 24 of TIA-606).

T3 – Telecommunications rooms – plan views – tech and AMEP / elevations – racks and wall elevations. T3 drawings provide telecommunications room details. These drawings indicate technology layout (racks, ladder-racks, etc.), mechanical/electrical layout, rack elevations, and backboard elevations. They may also be an enlargement of a congested area of T1 or T2 (examples of a T3 drawing level is shown in figure 33 with examples of T3 symbols are shown in figure 29 of TIA-606).

T4 – Typical detail drawings – faceplate labeling, firestopping, ADA, Safety, DOT, etc. T4 drawings provide details of symbols and typical components such as faceplate labeling, faceplate types, installation procedures, racking, and raceways.

T5 – Schedules. Schedules (spreadsheets) to show information for cutovers and cable plant management.

1.1.3 Telecommunication maintenance holes/vaults/hand holes

Telecommunication maintenance holes/vaults/hand holes shall meet existing infrastructure or approved equal, sized oriented correctly, and shall be installed IAW the UFC 3-580-01 (Nov 24'), RCDD design and manufacturer's instructions. Telecommunication maintenance holes/vaults/hand holes shall meet the following minimum criteria:

1.1.3.1 Concrete shall have a minimum compressive strength of 7000 psi at 28 days.

1.1.3.2 Design telecommunication maintenance holes/vaults/hand holes to meet ASHTO H-20 rating with a round lid.

1.1.3.3 Telecommunication maintenance holes/vaults shall have galvanized embedded pulling irons in each corner, top and bottom.

1.1.3.4 Telecommunication maintenance holes/vaults/hand holes shall have a minimum of four galvanized "C" channels per longitudinal side.

1.1.3.5 Equip telecommunication maintenance holes/vaults/hand holes with PVC duct terminators at all points of entry/termination (term-a-duct or similar).

1.1.3.6 Include galvanized steel access ladder in telecommunication maintenance holes/vault/hand holes.

1.1.3.7 Minimum depth of cover shall be 24 inches for telecommunication maintenance holes/vaults/hand holes.

1.1.3.8 Plug all unoccupied ducts, sub-ducts, and inner ducts – whether main or subsidiary runs – using universal screw-type duct plugs telecommunication maintenance holes/vaults/hand holes and at building entrances. Foam sealant is not acceptable.

1.1.3.9 Splice cases shall be of the pre-formed stainless-steel type for copper and Tyco (or approve equal) for fiber splice cases. "Stretch cases" are not allowed. Flash test using dry nitrogen gas to ensure dry and airtight seals. Splice cases shall be installed in such a manner that their weight is supported by the cable hooks in the maintenance hole/vault. Splice cases shall not be installed in hand holes without prior approval from the NEC.

1.1.4 Provide notification to NEC Plans Branch at least 48 hours prior to Installation of telecommunication maintenance holes/vaults/hand holes and obtain approval on their orientation.

1.1.5 Provide grounding and bonding, to include resistance testing/reports in and for all telecommunications maintenance holes/vaults/hand holes, to comply with the UFC 3-580-01/TIA-. Perforated ribbon shall not be used. All telecommunication maintenance holes/vaults/hand holes shall have grounding in accordance with the NFPA 70-(National Electrical Code), ANSI-C2, (NESC) and the criteria cited in the latest UFC 3-580-01.Methods shall comply with those cited in the RUS Bulletin 1751F-802 dated 12 Apr 94.Ground rods must meet requirements and be installed in accordance with NEMA GR-1.Ground rods must be steel that is copper-clad and a minimum of 0.75 inches (20millimeters) in diameter and a minimum of 10 feet (2.75 meters long). Four inches (100millimeters) of the rod, plus or minus 0.5 inches (13 millimeters) must extend above the finished floor level. All telecommunication maintenance holes/vaults/hand holes grounding shall achieve not greater than 25 ohms. Ground rods shall be spaced a distance equal to or greater than the length of the ground rods. Upon completion of the grounding system installation, the contractor shall provide a final ground resistance test report that uses the “fall of potential method”.

1.1.6 Provide labeling per TIA 606 and JBLM NEC Labeling Scheme Standards.

1.1.7 Telecommunication hand holes/vaults: Coordinate with DPW and the NEC Plans Branch Chief, IT Project Manager and QA Technician for use, application, and approval of all telecommunication hand holes/vaults at JBLM. The acceptable pull-point telecommunication hand hole size is 4 feet by 4 feet by 4 feet (1.2 meters by 1.2 meters by1.2 meters) and should be placed only as the last structure before a EUB and where there is no possibility that the conduit system will be extended. The acceptable splice-point telecommunications hand hole size is 5 feet by 7 feet.

1.1.8 Lightning Protection: Follow the UFC 3-580-01 paragraph 3-9.9.5 Building Telecommunications Grounding.

1.1.9 Telecommunications Cut-Over Plan: Follow the JBLM NEC Telecommunications Cut-Over Plan Template.

1.1.10 Telecommunications Inside Plant/Outside Plant (ISP/OSP) Check Sheet: Contractorfollow the JBLM NEC Telecommunications ISP/OSP Check Sheet.

1.1.11 Telecommunications Duct Banks:

1.1.11.1 In addition to the requirements of UFC 3-580-01, all duct banks in the Cantonment Area of JBLM shall be constructed of Schedule 40 PVC encased in 3,000 psi concrete. Duct bank bases shall be leveled and layered with a four-

inch layer of compactable bedding material. Duct spacers are required and the duct bank properly formed and framed prior to concrete pour.

1.1.11.2 All new ducts shall be mandrel-tested with a 12-inch nonflexible mandrel with a diameter that is ½-inch less than the duct inside diameter, except that a 6-inch nonflexible mandrel shall be used only at the final 90-degree rigid steel conduit sweep to the telecommunications room or pole riser. Mandrel pulls shall be witnessed by the NEC/DPW. All innerduct shall be UFC 3-580-01 compliant fabric mesh innerduct. Each4" ducts requiring innerduct shall contain fabric mesh tapes consisting of a minimum of three – 3-inch, 3-cell per tape, maximum of three tapes/nine cells per duct.

1.1.11.3 All newly installed duct runs require a minimum of 24-inches cover from top of duct.

1.1.11.4 If any existing communication ducts are identified within the proposed construction area, a comprehensive site survey shall be required to include Potholing to determine if the duct banks meet the current encasement requirement for bidding purposes. If existing ducts are exposed and do NOT meet the current encasement requirement, then ducts shall be encased to meet the current UFC 3-580-01 encasement requirement.

1.1.12 OSP Copper Cable:

1.1.12.1 All newly installed OSP copper cabling shall be considered, designed, installed and tested as special circuits (special circuits are defined as non-switched data circuits such as ISDN, DSL/ADSL or DS1/T1's).

1.1.12.2 All OSP copper cabling shall be tested to all the parameters of the RUS Bulletin 1753F-201 (PC-4) RUS Standard for Acceptance Test and Measurements of Telecommunications Plant and the 3-9.5.9 Acceptance Testing. All field test equipment shall meet the requirements of the TIA/EIA-568-C.2-Annix I and/or TIA/EIA-1152-2009.

1.1.13 OSP Fiber Cable:

1.1.13.1 All newly installed OSP fiber cabling shall be considered, designed, installed and tested in accordance with the UFC 3-580-01 paragraph 3-9.6 Fiber Optic Cable.

1.1.13.2 Fiber optic cables shall be engineered with a 20-foot (6-m) service loop installed in each pull-through telecommunications maintenance/vault/hand hole or a 50-foot (15-m) splice loop installed on each side of a splice case.

1.2 RELATED REQUIREMENTS

Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING SYSTEM, Section 33 71 01.00 40 OVERHEAD TRANSMISSION AND DISTRIBUTION, and Section 33 71 02

UNDERGROUND ELECTRICAL DISTRIBUTION, apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used

in this specification shall be as defined in TIA-568-C.1, TIA-568-C.2,

TIA-568-C.3, TIA-569, TIA-606, IEEE 100, and UFC 3-580-01 herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates.

(International expression for main cross-connect - (MC).)

1.3.2 Entrance Facility (EF) (Telecommunications)

Telecommunications Entrance Facility. An entrance facility (EF) is the space housing the point of entrance of the information communications technology service. The EF is also the space where the inter-building backbone and intra-building backbone facilities join.

The demarcation point between the outside plant (OSP) cabling and the inside plant distribution cabling is the protected entrance terminal (PET). An equipment room (ER) is an environmentally controlled, centralized space for information technology communications equipment that typically houses a main or intermediate cross-connect. Any or all the functions of a TR or EF may be provided by an equipment room.

1.3.3 Entrance Room (ER) (Telecommunications)

A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.4 Building Distributor (BD) A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect - (IC).)

1.3.5 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The telecommunication outside plant consists of cable, conduit, manholes, poles, etc. required to provide signal paths from the closest point of presence to the new facility, including free standing frames or backboards, interconnecting hardware, terminating cables, lightning and surge protection modules at the entrance facility. The work consists of providing, testing and making operational cabling, interconnecting hardware and lightning and surge protection necessary to form a complete outside plant Telecommunications system for continuous use. The telecommunications contractor may coordinate with the NEC concerning layout and configuration of the EF telecommunications and OSP. The telecommunications contractor may be required to coordinate work effort for access to the EF telecommunications and OSP with the Joint Base Lewis McChord (JBLM) personnel (such as COE, DPW, JBLM NEC, YTC NEC, and 627CS.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control. The JBLM NEC project team shall perform a technical review of all telecommunications submittals and requests for information (RFI)s for each project and provide review comments to the Government project team.

submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Prior to the government's approval of telecommunications cable cutover plan submittals, the government project team must have the JBLM NEC project team's technical review comments and approval. This is necessary because of the coordination required for outside agency approval processes and scheduling of service interruptions to minimize the impact on the services JBLM NEC provides to its customers. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02

Shop Drawings Telecommunications Outside Plant; G (NEC review)

Telecommunications Entrance Facility Drawings; G (NEC review)

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Wire and cable; G (NEC review)

Cable splices, and connectors; G (NEC review)

Closures; G (NEC review)

Building protector Assemblies; G (NEC review)

Protector modules; G (NEC review)

Cross-connect terminal cabinets; G (NEC review)

Spare Parts; G (NEC review)

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required for certificates in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Pre-installation tests; G (NEC review)

Acceptance tests; G (NEC review)

Outside Plant Test Plan; G (NEC review)

Existing Cable Pre-Test Failure Report

SD-07 Certificates

Telecommunications Contractor Qualifications; G (NEC review)

Key Personnel Qualifications; G (NEC review)

Minimum Manufacturer's Qualifications; G (NEC review)

SD-08 Manufacturer's Instructions

Building protector assembly installation; G (NEC review)

Cable tensions; G (NEC review)

Fiber Optic Splices; G (NEC review)

Submit instructions prior to installation.

SD-09 Manufacturer's Field Reports

Factory Reel Test Data; G (NEC Review)

Factory Reel Test Data; G

SD-10 Operation and Maintenance Data

Telecommunications outside plant (OSP), Data Package 5; G (NEC review)

Commercial off-the-shelf manuals shall be provided for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications outside plant (OSP). Submit operations and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data package 5, include the requirements of paragraphs TELECOMMUNICATIONS OUTSIDE PLANT SHOP DRAWINGS and

TELECOMMUNICATIONS ENTRANCE FACILITY DRAWINGS.

SD-11 Closeout Submittals

Record Documentation; G (NEC review)

In addition to other requirements, provide in accordance with paragraph RECORD DOCUMENTATION.

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

Include wiring diagrams and installation details of equipment indicating

proposed location, layout and arrangement, control panels, accessories,

piping, ductwork, and other items that must be shown to ensure a coordinated

installation. Wiring diagrams shall identify circuit terminals and indicate

the internal wiring for each item of equipment and the interconnection between

each item of equipment. Drawings shall indicate adequate clearance for

operation, maintenance, and replacement of operating equipment devices.

Submittals shall include the nameplate data, size, and capacity. Submittals

shall also include applicable federal, military, industry, and technical

society publication references.

Telecommunication Drawings: Follow the TIA-606 and JBLM NEC Telecommunications Drawing Template. Standard telecommunication drawings are:

T0 – Campus or site plans – exterior pathways and campus cabling.

T1 – Layout of complete building per floor – building area/serving zone boundaries, Cabling Subsystem 1, 2, and 3 pathways.

T2 – Serving zones/building area drawings – drop locations and cable ID's. T2 drawings show a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas (examples of a T2 drawing level is shown in figure 32 with examples of T2 symbols are shown in figure 28, and T2 general pathway conditions are listed in figure 24 of TIA-606).

T3 – Telecommunications rooms – plan views – tech and AMEP / elevations – racks and wall elevations. T3 drawings provide telecommunications room details. These drawings indicate technology layout (racks, ladder-racks, etc.), mechanical/electrical layout, rack elevations, and backboard elevations. They may also be an enlargement of a congested area of T1 or T2 (examples of a T3 drawing level is shown in figure 33 with examples of T3 symbols are shown in figure 29 of TIA-606).

T4 – Typical detail drawings – faceplate labeling, firestopping, ADA, Safety, DOT, etc. T4 drawings provide details of symbols and typical components such as faceplate labeling, faceplate types, installation procedures, racking, and raceways.

T5 – Schedules. Schedules (spreadsheets) to show information for cutovers and cable plant management.

1.6.1.1 Telecommunications Outside Plant Shop Drawings

Provide Outside Plant Design in accordance with TIA-758, RUS Bull 1751F-630 for aerial system design, RUS Bull 1751F-643, and UFC 3 580-01. UFC 3 580-01 Tables 2-1 and 2-2 list expected submissions and when they are due in the process. These timeframes may be adjusted for fast-tracked or other delivery mechanisms to align with design processes.

for underground system design. Provide T0 shop drawings that show the physical and logical connections from the perspective of an entire campus, such as actual building locations, exterior pathways and campus backbone cabling on plan view drawings, major system nodes, and related connections on the logical system drawings in accordance with TIA-606. Drawings shall include wiring and schematic diagrams for fiber optic and copper cabling and splices, copper conductor gauge and pair count, fiber pair count and type, pathway duct and innerduct arrangement, associated construction materials, and any

details required to demonstrate that cable system has been coordinated and will properly support the switching and transmission system identified in specification and drawings. Provide Registered Communications Distribution Designer (RCDD) approved drawings of the telecommunications outside plant. Update existing telecommunication Outside Plant T0 drawings to include information modified, deleted or added as a result of this installation in accordance with TIA-606. The telecommunications outside plant (OSP) shop drawings shall be included in the operation and maintenance manuals.

1.6.1.2 Telecommunications Entrance Facility

Provide drawings that include telecommunications entrance facility plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and cabinet, rack, backboard and] wall elevations. Drawings shall show layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of T1 or T2 drawings. Provide T3 drawings for EF Telecommunications as specified in the paragraph TELECOMMUNICATIONS SPACE DRAWINGS of Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEMS. The telecommunications entrance facility shop drawings shall be included in the operation and maintenance manuals.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, the supervisor (if different from the installer), and the cable splicing and terminating personnel. A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor Qualifications

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems that include outside plant and broadband cabling within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system

installations for the telecommunications contractor. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems in accordance with TIA-758 within the past 3 years.

1.6.2.2 Key Personnel Qualifications

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Cable splicing and terminating personnel assigned to the installation of this system or any of its components shall have training in the proper techniques and have a minimum of 3 years' experience in splicing and terminating the specified cables. Modular splices shall be performed by factory certified personnel or under direct supervision of factory trained personnel for products used.

Supervisors and installers assigned to the installation of this system or any of its components shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel.

Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications outside plant systems, including broadband cabling, and provide the names and locations of at least two project installations successfully completed using [optical fiber and] copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All ey

persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

1.6.2.3 Minimum Manufacturer's Qualifications

Cabling equipment and hardware manufacturers shall have a minimum of 3 years' experience in the manufacturing, assembly, and factory testing of components which comply with, TIA-568-C.1, TIA-568-C.2 and TIA-568-C.3. In addition, cabling manufacturers shall have a minimum of 3 years' experience in the manufacturing and factory testing of cabling which complies with ICEA S-87-640, ICEA S-98-688, and ICEA S-99-689.

1.6.3 Outside Plant Test Plan

Prepare and provide a complete and detailed test plan for field tests of the outside plant including a complete list of test equipment for the copper conductor and optical fiber cables, components, and accessories for approval by the Contracting Officer. Include a cut-over plan with procedures and schedules for relocation of facility station numbers without interrupting service to any active location. Submit the plan at least 30 days prior to tests for Contracting Officer approval. Provide outside plant testing and performance measurement criteria in accordance with the UFC 3-580-01, TIA-568-C.1 and RUS Bull 1753F-201. Include procedures for certification, validation, and testing that include fiber optic link performance criteria. A Registered Communications Distribution Designer (RCDD) shall stamp and approve both the test plan and test report.

1.6.4 Standard Products

Provide materials and equipment that are standard products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and shall be the manufacturer's latest standard design that has been in satisfactory commercial or industrial use for at least 2 year[s prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems. Where two or more items of the same class of

equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is provided.

1.6.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6.5 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.5.1 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.7 DELIVERY, STORAGE, AND HANDLING

Ship cable on reels in 305 meter (1000 feet) 1000] feet length with a minimum overage of 10 percent. Radius of the reel drum shall not be smaller than the minimum bend radius of the cable. Wind cable on the reel so that unwinding can be done without kinking the cable. Two meters of cable at both ends of the cable shall be accessible for testing. Attach permanent label on each reel showing length, cable identification number, cable size, cable type, and date of manufacture. Provide water resistant label and the indelible writing on the labels. Apply end seals to each end of the cables to prevent moisture from entering the cable. Reels with cable shall be suitable for outside storage conditions when temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent.

Equipment, other than cable, delivered and placed in storage shall be stored with protection from weather, humidity and temperature variation, dirt and dust, or other contaminants in accordance with manufacturer's requirements.

1.8 MAINTENANCE

1.8.1 Record Documentation

Provide the activity responsible for telecommunications system maintenance and administration a single complete and accurate set of record documentation for the entire telecommunications system with respect to this project. Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided in hard copy format on electronic media using Windows based computer cable management software. A licensed copy of the cable management software including documentation, shall be provided. Update existing record documentation to reflect campus distribution T0 drawings and T3 drawing schedule information modified, deleted or added as a result of this installation.] Provide the following T5 drawing documentation as a minimum:

a. Cables - A record of installed cable shall be provided in accordance with TIA-606. The cable records shall [include only the required data fields include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility]in accordance with TIA-606. Include manufacture date of cable with submittal.

b. Termination Hardware - Provide a record of installed patch panels, cross connect points, campus distributor and terminating block arrangements and type in accordance with TIA-606. Documentation shall include the required data fields as a minimum in accordance with TIA-606. Provide record documentation as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

1.8.2 Spare Parts

In addition to the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking. Spare parts shall be provided no later than the start of field testing.

1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems.

2.2 TELECOMMUNICATIONS ENTRANCE FACILITY

2.2.1 Building Protector Assemblies

Provide self-contained screw type unit supplied with a field cable stub factory connected to protector socket blocks to terminate and accept protector modules for 25 pairs of outside cable. Building protector assembly shall have interconnecting hardware for connection to interior cabling at full capacity. Provide manufacturer's instructions for building protector assembly installation. Provide copper cable interconnecting hardware as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.2.2 Protector Modules

Provide in accordance with UL 497 gas tube 5 pin rated for the application or Provide gas tube protection modules in accordance with RUS Bull 345-83 and shall be heavy duty, A>10kA, B>400, C>65A where A is the maximum single impulse discharge current, B is the impulse life and C is the AC discharge current in accordance with ANSI C62.61. The gas modules shall shunt high voltage to ground, fail short, and be equipped with an external spark gap and heat coils in accordance with UL 497. Provide the number of surge protection modules equal to the number of pairs of exterior cable of the building protector assembly.

2.2.3 Fiber Optic Terminations

Provide fiber optic cable terminations as specified in 27 10 00 BUILDING

TELECOMMUNICATIONS CABLING SYSTEM.

2.3 CLOSURES

2.3.1 Copper Conductor Closures

2.3.1.1 Aerial Cable Closures

Provide cable closure assembly consisting of a frame with clamps, a lift-off polyethylene cover, cable nozzles, and drop wire rings. Closure shall be suitable for use on Figure 8 cables. Closures shall be free breathing and suitable for housing [straight-through type][branch type][of the type indicated] splices of non-pressurized communications cables and shall be sized as indicated. The closure shall be constructed with ultraviolet resistant PVC.

2.3.1.2 Underground Cable Closures

a. Aboveground: Provide aboveground closures constructed of[not less than 14-gauge steel][ultraviolet resistant PVC] and acceptable for[pole][stake] mounting in accordance with RUS 1755.910. Closures shall be sized and contain a marker as indicated. Covers shall be secured to prevent unauthorized entry.

b. Direct burial: Provide buried closure suitable for enclosing a straight, butt, and branch splice in a container into which can be poured an encapsulating compound. Closure shall have adequate strength to protect the splice and maintain cable shield electrical continuity in the buried environment. Encapsulating compound shall be re-enterable and shall not alter the chemical stability of the closure. Provide filled splice cases in accordance with RUS Bull 345-72.

c. In vault or maintenance hole: Provide underground closure suitable to house a straight, butt, and branch splice in a protective housing (pre-formed stainless-steel type for copper and “Tyco’’ or an approved equal for fiber). Closure shall be of suitable thermoplastic, thermoset, or stainless-steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or maintenance hole environment. Encapsulating compound shall not be used. “Stretch cases” are not allowed. Do not use encapsulating compounds. Flash test using dry nitrogen gas to ensure dry and airtight seals. Splice cases shall be installed in such a manner that their weight is supported by the cable hooks in the maintenance hole/vault.

2.3.2 Fiber Optic Closures

2.3.2.1 Aerial

Provide aerial closure that is free breathing and suitable for housing splice organizer of non -pressurized cables. Closure shall be constructed from heavy PVC with ultraviolet resistance.

2.3.2.2 Direct Burial

Provide buried closure suitable to house splice organizer in protective housing into which an encapsulating compound can be poured. Closure shall have adequate strength to protect the splice and maintain cable shield electrical continuity, when metallic, in buried

environment. Encapsulating compound shall be re-enterable and shall not alter chemical stability of the closure.

2.3.2.3 In Vault or Manhole

Provide underground closure suitable to house splice organizer in a protective housing (“Tyco’’ or an approved equal. Closure shall be of thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall not be used. Do not use encapsulating compounds. Flash test using dry nitrogen gas to ensure dry and airtight seals. Splice cases shall be installed in such a manner that their weight is supported by the cable hooks in the maintenance hole/vault.

2.4 PAD MOUNTED CROSS-CONNECT TERMINAL CABINETS

Provide in accordance with RUS 1755.910 and the following:

a. Constructed of 14 gauge steel or [_____].

b. Equipped with a double set of hinged doors with closed-cell foam weatherstripping. Doors shall be locked and contain a marker as indicated.

c. Equipped with spool spindle bracket, mounting frames, binding post log, [and] jumpering instruction label [, and load coil mounting provisions].

d. Complete with cross connect modules to terminate number of pairs as indicated.

e. Sized as indicated.

2.5 CABLE SPLICES, AND CONNECTORS

2.5.1 Copper Cable Splices

Provide multipair, foldback splices of a moisture resistant, insulation displacement connector held rigidly in place to assure maximum continuity in accordance with RUS Bull 1753F-401. Cables greater than 25 pairs shall be spliced using multipair splicing connectors, which accommodate 25 pairs of conductors at a time. Provide correct connector size to accommodate the cable gauge of the supplied cable.

2.5.2 Copper Cable Splice Connector

Provide splice connectors with a polycarbonate body and cap and a tin-plated brass contact element. Connector shall accommodate 22 to 26 AWG solid wire with a maximum insulation diameter of 1.65 mm 0.065 inch. Fill connector with sealant grease to make a moisture resistant connection, in accordance with RUS Bull 1753F-401.

2.5.3 Fiber Optic Cable Splices

Provide fiber optic cable splices and splicing materials for fusion methods at locations shown on the construction drawings. The splice insertion loss shall be <0.05 dB maximum when measured in accordance with TIA-455-78-B using an Optical Time Domain Reflectometer (OTDR). Splices shall be designed for a return loss of 40.0 dB max for single mode fiber when tested in accordance with TIA-455-107. Physically protect each fiber optic splice by a splice kit specially designed for the splice.

2.5.4 Fiber Optic Splice Organizer

Provide splice organizer suitable for housing fiber optic splices in a neat and orderly fashion. Splice organizer shall allow for a minimum of 1 m 3 feet of fiber for each fiber within the cable to be neatly stored without kinks or twists. Splice organizer shall accommodate individual strain relief for each splice and allow for future maintenance or modification, without damage to the cable or splices. Provide splice organizer hardware, such as splice trays, protective glass shelves, and shield bond connectors in a splice organizer kit.

2.5.5 Shield Connectors

Provide connectors with a stable, low-impedance electrical connection between the cable shield and the bonding conductor in accordance with RUS Bull 345-65.

2.6 CONDUIT

Provide conduit as specified in Section 33 71 02 UNDERGROUND ELECTRICAL

DISTRIBUTION.

2.7 PLASTIC INSULATING TAPE

UL 510.

2.8 WIRE AND CABLE

2.8.1 Copper Conductor Cable

Solid copper conductors, covered with an extruded solid insulating compound. Insulated conductors shall be twisted into pairs which are then stranded or oscillated to form a cylindrical core. For special high frequency applications, the cable core shall be separated into compartments. Cable shall be completed by the application of a suitable core wrapping material, a corrugated copper or plastic coated aluminum shield, and an overall extruded jacket. Telecommunications contractor shall verify distances between splice

points prior to ordering cable in specific cut lengths. Gauge of conductor shall determine the range of numbers of pairs specified; 19 gauge (6 to 400 pairs), 22 gauge (6 to 1200 pairs), 24 gauge (6 to 2100 pairs), and 26 gauge (6 to 3000 pairs). Copper conductor shall conform to the following:

2.8.1.1 Underground

Provide filled cable meeting the requirements of ICEA S-99-689 and [RUS 1755.390][RUS 1755.890].

2.8.1.2 Aerial

Provide filled cable meeting the requirements of[ICEA S-99-689][ICEA S-98-688], and RUS 1755.390 except that it shall be suitable for aerial installation and shall be Figure 8 distribution wire with 26,700 N 6,000 pound Class A galvanized steel or 26,700 N 6,000 pound aluminum-clad steel strand.

2.8.1.3 Screen

Provide screen-compartmental core cable filled cable meeting the requirements of ICEA S-99-689 and RUS 1755.390.

2.8.2 Fiber Optic Cable

Provide[single-mode, 8/125-um, 0.10 aperture 1310 nm fiber optic cable in accordance with TIA-492CAAA][single-mode, 8/125-um, 0.10 aperture 1550 nm fiber optic cable in accordance with TIA-492E000][and][multimode 62.5/125-um, 0.275 aperture fiber optic cable in accordance with TIA-492AAAA][multimode 50/125-um, 0.275 aperture fiber optic cable in accordance with TIA-492AAAB], TIA-472D000, and ICEA S-87-640 including any special requirements made necessary by a specialized design. Provide 12 single-mode optical fibers strands [as indicated]. Fiber optic cable shall be specifically designed for outside use with loose buffer construction. Provide fiber optic color code in accordance with TIA/EIA-598.

2.8.2.1 Strength Members

Provide central non-metallic strength members with sufficient tensile strength for installation and residual rated loads to meet the applicable performance requirements in accordance with ICEA S-87-640. The strength member is included to serve as a cable core foundation to reduce strain on the fibers, and shall not serve as a pulling strength member.

2.8.2.2 Shielding or Other Metallic Covering

Provide bare aluminum or coated aluminum, single tape covering or shield in accordance with ICEA S-87-640.

2.8.2.3 Performance Requirements

Provide fiber optic cable with optical and mechanical performance requirements in accordance with ICEA S-87-640.

2.8.3 Grounding and Bonding Conductors

Provide grounding and bonding conductors in accordance with RUS 1755.200, TIA-607, IEEE C2, and NFPA 70 and Solid bare copper wire meeting the requirements of ASTM B1 for sizes No. 8 AWG and smaller and stranded bare copper wire meeting the requirements of ASTM B8, for sizes No. 6 AWG and larger. Insulated conductors shall have 600-volt, Type TW insulation meeting the requirements of UL 83. Provide grounding and bonding conductors in accordance with" ADD: "UFC 3-580-01" ADD: "In underground structures, a bonding ribbon must be installed around the interior of each supporting structure so that splice cases and rack anchors can be bonded. Install a bonding ribbon in each half of two-part MHs. Permanently bond the top and bottom ribbons to the integrated ground system.

2.9 T-SPAN LINE TREATMENT REPEATERS

Provide as indicated. Repeaters shall be pedestal mounted with non-pressurized housings, sized as indicated and shall meet the requirements of RUS Bull 345-50.

2.10 POLES AND HARDWARE

Provide poles and hardware as specified in Section 33 71 00.00 40 OVERHEAD TRANSMISSION AND DISTRIBUTION.

2.11 CABLE TAGS IN MAINTENANCE HOLES, HAND HOLES, AND VAULTS

Provide tags for each telecommunications cable or wire located in maintenance holes, handholes, and vaults. Cable tags shall be polyethylene and labeled in accordance with TIA/EIA-606-A and JBLM NEC Labeling Scheme. Handwritten labeling is unacceptable. No metal tags.

2.11.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop

tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

2.12 BURIED WARNING AND IDENTIFICATION TAPE AND TRACER WIRE

Provide fiber optic media marking and protection in accordance with TIA-590. Provide polyethylene warning tape with a minimum width of 6-inches and imprinted with the words "WARNING - TELECOMMUNICATION CABLE BELOW" at intervals not more than 48-inch. Warning tape shall comply with APWA Uniform Color Code. Tape shall have a minimum thickness of 0.004 inch, and a minimum strength of 1750 pounds per square inch (PSI) lengthwise and 1500 PSI crosswise. Warning tape shall be manufactured with an integral wire, foil backing or other means of enabling detection by a metal detector or underground cable detector. The warning tape shall be chemically inert and resistant to degradation caused by acids, alkalis, and other destructive substances found in soil.

Tracer wire shall be #12 AWG insulated solid copper with a minimum 30-mm PE jacket designed specifically for buried use. Splices in the tracer wire shall be a compression type connector to ensure continuity. Wire nuts shall not be used.

2.13 GROUNDING BRAID

Provide grounding braid that provides low electrical impedance connections for dependable shield bonding in accordance with RUS 1755.200. Braid shall be made from flat tin-plated copper.

2.14 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.15 FIELD FABRICATED NAMEPLATES

Provide laminated plastic nameplates in accordance with ASTM D 709 for each patch panel, protector assembly, rack, cabinet and other equipment or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.16 TESTS, INSPECTIONS, AND VERIFICATIONS

2.16.1 Factory Reel Test Data

Test 100 percent OTDR test of FO media at the factory in accordance with TIA-568-C.1 and TIA-568-C.3. Use TIA-526-7 for single mode fiber and TIA-526-14 Method B for multi-mode fiber measurements. Calibrate OTDR to show anomalies of 0.2 dB minimum. Enhanced performance filled OSP copper cables, referred to as Broadband Outside Plant (BBOSP), shall meet the requirements of ICEA S-99-689. Enhanced performance air core OSP copper cables shall meet the requirements of ICEA S-98-688. Submit test reports, including manufacture date for each cable reel and receive approval before delivery of cable to the project site.

PART 3 EXECUTION

3.1 INSTALLATION

Install all system components and appurtenances in accordance with manufacturer's instructions, install all system components and appurtenances in accordance with UFC 3-580-01 (21 Nov 24), paragraph 3-1.1,IEEE C2, NFPA 70, and as indicated. Provide all necessary interconnections, services, and adjustments required for a complete and operable telecommunications system. Building telecommunications infrastructure and cabling shall be installed in accordance with NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling. Workmanship shall conform to the practices described in the BICSI Information Transport Systems Installation Methods Manual (ITSIMM).

3.1.1 Contractor Damage

Promptly repair indicated utility lines or systems damaged during site preparation and construction. Damages to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the Contract Clauses. When Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In every event, immediately notify the Contracting Officer of damage.

3.1.2 Cable Inspection and Repair

Handle cable and wire provided in the construction of this project with care. Inspect cable reels for cuts, nicks or other damage. Damaged cable shall be replaced or repaired to the satisfaction of the Contracting Officer. Reel wraps shall remain intact on the reel until the cable is ready for placement.

3.1.3 Underground Duct

Provide underground duct and connections to existing maintenance holes, and existing ducts in accordance with UFC 3-580-01 (21 Nov 24), paragraph: 1-2, and as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION with any additional requirements as specified herein. PVC ducts shall be installed with a minimum of 36 inches of cover over the encasement. Ducts shall enter maintenance holes at the bottom-most holes, deep enough to allow all maintenance hole entrance ports (used now or in the future) to have ducts installed to maintain minimum cover over the uppermost duct. Locate metallic warning tape above ducts at 12 to 18 inches above the encasement but at least 12 inches below grade and continuous above maintenance holes. All new and existing ducts utilized in the project shall be thoroughly cleaned prior to installing cables. A mandrel not less than 12 inches long with a diameter 1/2 inch less than the inside diameter of the duct shall be pulled through each duct. Pneumatic rodding may be used to draw in the lead wire/cord.

Install tracer wire in all new duct banks. The tracer wire shall be placed exterior to the conduit in the center of the top conduit formation. Tracer wire shall be placed prior to the concrete pour. Splices in the tracer wire shall compression type to ensure continuity. Wire nuts are not allowed. After installation, provide continuity test of tracer wire and submit a report to the Quality Control Representative as part of the construction record documents.

Plug all ducts, sub-ducts, and innerducts, whether main or subsidiary runs, using universal screw type duct plugs in telecommunications maintenance holes and handholes and at building entrances. Foam sealant is not acceptable.

3.1.3 Direct Burial System

Installation shall be in accordance with RUS Bull 1751F-640. Under railroad tracks, paved areas, and roadways install cable in conduit encased in concrete. Slope ducts to drain. Excavate trenches by hand or mechanical trenching equipment. Provide a minimum cable cover of 610 mm 24 inches below finished grade. Trenches shall be not less than 155 mm 6 inches wide and in straight lines between cable markers. Do not use cable plows. Bends in trenches shall have a radius of not less than [915][_____] mm [36][_____] inches. Where two or more cables are laid parallel in the same trench, space laterally at least 78 mm 3 inches apart. When rock is encountered, remove it to a depth of at least 78 mm 3 inches below the cable and fill the space with sand or clean earth free from particles larger than 6 mm 1/4 inch. Do not unreel and pull cables into the trench from one end. Cable may be unreeled on grade and lifted into position. Provide color, type and depth of warning tape as specified in paragraph BURIED WARNING AND IDENTIFICATION TAPE in Section 31 00 00 EARTHWORK.

3.1.3.1 Cable Placement

a. Separate cables crossing other cables or metal piping from the other cables or pipe by not less than [78][_____] mm [3][_____] inches of well tamped earth. Do not install circuits for communications under or above traffic signal loops.

b. Cables shall be in one piece without splices between connections except where the distance exceeds the lengths in which the cable is furnished.

c. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.

d. Leave a horizontal slack of approximately 915 mm 3 feet in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought above ground. Where cable is brought aboveground, leave additional slack to make necessary connections.

3.1.3.2 Identification Slabs [Markers]

Provide a marker at each change of direction of the cable, over the ends of ducts or conduits which are installed under paved areas and roadways and over each splice. Identification markers shall be of concrete, approximately 508 mm 20 inches square by 155 mm 6 inches thick.

3.1.3.3 Backfill for Rocky Soil

When placing cable in a trench in rocky soil, the cable shall be cushioned by a fill of sand or selected soil at least 53 mm 2 inches thick on the floor of the trench before placing the cable or wire. The backfill for at least 103 mm 4 inches above the wire or cable shall be free from stones, rocks, or other hard or sharp materials which might damage the cable or wire. If the buried cable is placed less than 610 mm 24 inches in depth[, a protective cover of[metal][concrete] shall be used].

3.1.4 Cable Protection

Provide direct burial cable protection in accordance with NFPA 70 and as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Galvanized conduits which penetrate concrete (slabs, pavement, and walls) shall be PVC coated and shall extend from the first coupling or fitting outside either side of the concrete minimum of 155 mm per 305 mm 6 inches per 12 inches burial depth beyond the edge of the surface where cable protection is required; all conduits shall be sealed on each end. Where additional protection is required, cable may be placed in galvanized iron pipe (GIP) sized on a maximum fill of 40 percent of cross-sectional area, or in concrete encased 103 mm 4

inches PVC pipe. Conduit may be installed by jacking or trenching. Trenches shall be backfilled with earth and mechanically tamped at 155 mm 6 inches lift so that the earth is restored to the same density, grade and vegetation as adjacent undisturbed material.

3.1.4.1 Cable End Caps

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.1.5 Reconditioning of Surfaces

Provide reconditioning of surfaces as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.1.6 Penetrations

Caulk and seal cable access penetrations in walls, ceilings and other parts of the building. Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.7 Cable Pulling

Test duct lines with a mandrel and swab out to remove foreign material before the pulling of cables. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not step on cables when entering or leaving the manhole. Do not place cables in ducts other than those shown without prior written approval of the Contracting Officer. Roll cable reels in the direction indicated by the arrows painted on the reel flanges. Set up cable reels on the same side of the manhole as the conduit section in which the cable is to be placed. Level the reel and bring into proper alignment with the conduit section so that the cable pays off from the top of the reel in a long smooth bend into the duct without twisting. Under no circumstances shall the cable be paid off from the bottom of a reel. Check the equipment set up prior to beginning the cable pulling to avoid an interruption once pulling has started. Use a cable feeder guide of suitable dimensions between cable reel and face of duct to protect cable and guide cable into the duct as it is paid off the reel. As cable is paid off the reel, lubricate and inspect cable for sheath defects. When defects are noticed, stop pulling operations and notify the Contracting Officer to determine required corrective action. Cable pulling shall also be stopped when reel binds or does not pay off freely. Rectify cause of binding before resuming pulling

operations. Provide cable lubricants recommended by the cable manufacturer. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.

3.1.7.1 Cable Tensions

Obtain from the cable manufacturer and provide to the Contracting Officer, the maximum allowable pulling tension. This tension shall not be exceeded.

3.1.7.2 Pulling Eyes

Equip cables 32 mm 1.25 inches in diameter and larger with cable manufacturer's factory installed pulling-in eyes. Provide cables with diameter smaller than 32 mm 1.25 inches with heat shrinkable type end caps or seals on cable ends when using cable pulling grips. Rings to prevent grip from slipping shall not be beaten into the cable sheath. Use a swivel of 19 mm 3/4 inch links between pulling-in eyes or grips and pulling strand.

3.1.7.3 Installation of Cables in Manholes, Handholes, and Vaults

Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support cables on brackets and cable insulators at a maximum of 4 feet. In existing maintenance holes, handholes, and vaults where new ducts are to be terminated, or where new cables are to be installed, modify the existing installation of cables, cable supports, and grounding as required with cables arranged and supported as specified for new cables. Identify each cable with corrosion-resistant embossed tags. Coordinate cable labeling with JBLM NEC through the Contracting Officer's Representative. Cable labeling shall comply with the JBLM NEC Labeling Scheme.

3.1.8 Aerial Cable Installation

Pole installation shall be as specified in Section 33 71 00.00 40 OVERHEAD TRANSMISSION AND DISTRIBUTION. Where physical obstructions make it necessary to pull distribution wire along the line from a stationary reel, use cable stringing blocks to support wire during placing and tensioning operations. Do not place ladders, cable coils, and other equipment on or against the distribution wire. Wire shall be sagged in accordance with the data shown. Protect cable installed outside of building less than 2.5 meters 8 feet above finished grade against physical damage.

3.1.8.1 Figure 8 Distribution Wire

Perform spiraling of the wire within 24 hours of the tensioning operation. Perform spiraling operations at alternate poles with the approximate length of the spiral being 4575 mm 15

feet. Do not remove insulation from support members except at bonding and grounding points and at points where ends of support members are terminated in splicing and dead-end devices. Ground support wire at poles to the pole ground.

3.1.8.2 Suspension Strand

Place suspension strand as indicated. Tension in accordance with the data indicated. When tensioning strand, loosen cable suspension clamps enough to allow free movement of the strand. Place suspension strand on the roadside of the pole line. In tangent construction, point the lip of the suspension strand clamp toward the pole. At angles in the line, point the suspension strand clamp lip away from the load. In level construction place the suspension strand clamp in such a manner that it will hold the strand below the through bolt. At points where there is an up-pull on the strand, place clamp so that it will support strand above the throughbolt. Make suspension strand electrically continuous throughout its entire length, bond to other bare cables suspension strands and connect to pole ground at each pole.

3.1.8.3 Aerial Cable

Keep cable ends sealed at all times using cable end caps. Take cable from reel only as it is placed. During placing operations, do not bend cables in a radius less than 10 times the outside diameter of cable. Place temporary supports sufficiently close together and properly tension the cable where necessary to prevent excessive bending. In those instances where spiraling of cabling is involved, accomplish mounting of enclosures for purposes of loading, splicing, and distribution after the spiraling operation has been completed.

3.1.9 Cable Splicing

3.1.9.1 Copper Conductor Splices

Perform splicing in accordance with requirements of RUS Bull 1753F-401 except that direct buried splices and twisted and soldered splices are not allowed. Exception does not apply for pairs assigned for carrier application. Do not use encapsulating compounds. Flash test using dry nitrogen gas to ensure dry and airtight seals.

3.1.9.2 Fiber Optic Splices

Fiber optic splicing shall be in accordance with manufacturer's recommendation and shall exhibit an insertion loss not greater than 0.2 dB for fusion splices. Do not use encapsulating compounds. Flash test using dry nitrogen gas to ensure dry and airtight seals.

3.1.10 Surge Protection

All cables and conductors, except fiber optic cable, which serve as communication lines through off-premise lines, shall have surge protection installed at each end which meets the requirements of RUS Bull 1751F-815.

3.1.11 Grounding

Provide grounding and bonding in accordance with RUS 1755.200, TIA J-STD-607, IEEE C2, and NFPA 70. Ground exposed noncurrent carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals. Provide grounding and bonding in accordance with UFC 3-580-01.

3.1.11.1 Telecommunications Master Ground Bar (TMGB)

The TMGB is the hub of the basic telecommunications grounding system providing a common point of connection for ground from outside cable, CD, and equipment. Establish a TMGB for connection point for cable stub shields to connector blocks and CD protector assemblies as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.11.2 Incoming Cable Shields

Shields shall not be bonded across the splice to the cable stubs. Ground shields of incoming cables in the EF Telecommunications to the TMGB.

3.1.11.3 Campus Distributor Grounding

a. Protection assemblies: Mount CD protector assemblies directly on the telecommunications backboard. Connect assemblies mounted on each vertical frame with No. 6 AWG copper conductor to provide a low resistance path to TMGB.

b. TMGB connection: Connect TMGB to TGB with copper conductor with a total resistance of less than 0.01 ohms.

3.1.12 Cut-Over

All necessary transfers and cutovers shall be accomplished by the telecommunications contractor. The RCDD shall render, stamp and approve the Cut-Over Plan in accordance with UFC 3-580-01 and ANSI/TIA-606.

3.1.13 Evaluating Existing Cable Plant

When installation includes work on existing cable plant (e.g., copper cable and fiberoptic cable) that is to be re-used, the installer shall test all affected pairs before completing any throws or splices. Test results must be compiled, to include any defective pairs and/or

strands identified, and submitted to the COR to be addressed by the USG prior to proceeding with installation." After the cable work is completed, the installer shall test all affected cable pairs. The installer shall also clear trouble on any existing pairs that were not on the original list.". Existing Cable Pre-Test Failure Report

3.2 LABELING

3.2.1 Labels

Provide labeling for new cabling and termination hardware located within the facility in accordance with ANSI/TIA-606 and JBLM NEC Labeling Scheme. Handwritten labeling is unacceptable. Stenciled lettering for cable and termination hardware shall be provided using thermal ink transfer process.

3.2.2 Cable Tag Installation

Install cable tags for each telecommunications cable or wire located in maintenance holes, handholes, and vaults including each splice. Tag new wire and cable provided under this contract and existing wire and cable which are indicated to have splices and terminations provided by this contract. The labeling of telecommunications cable tag identifiers shall be in accordance with ANSI/EIA-606 and JBLM NEC Labeling Scheme. Do not provide handwritten letters. Install cable tags so that they are clearly visible without disturbing any cabling or wiring in the maintenance holes, handholes, and vaults.

3.2.3 Termination Hardware

Label patch panels, distribution panels, connector blocks and protection modules using color coded labels with identifiers in accordance with ANSI/TIA-606.

3.3 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.4 FIELD QUALITY CONTROL

Provide the Contracting Officer 10 working day notice prior to each test. Provide labor, equipment, and incidentals required for testing. Correct SECTION 33 82 00 Page 19 defective material and workmanship disclosed as the results of the tests. Furnish a signed copy of the test results to the Contracting Officer within 3 working days after the tests for each segment of construction are completed.

Perform testing as construction progresses and do not wait until all construction is complete before starting field tests.

3.4.1 Pre-Installation Tests

Perform the following tests on cable at the job site before it is removed from the cable reel. For cables with factory installed pulling eyes, these tests shall be performed at the factory and certified test results shall accompany the cable.

3.4.1.1 Cable Capacitance

Perform capacitance tests on at least 10 percent of the pairs within a cable to determine if cable capacitance is within the limits specified.

3.4.1.2 Loop Resistance

Perform DC-loop resistance on at least 10 percent of the pairs within a cable to determine if DC-loop resistance is within the manufacturer's calculated resistance.

3.4.1.3 Pre-Installation Test Results

Provide results of pre-installation tests to the Contracting Officer at least 5 working days before installation is to start. Results shall indicate reel number of the cable, manufacturer, size of cable, pairs tested, and recorded readings. When pre-installation tests indicate that cable does not meet specifications, remove cable from the job site.

3.4.2 Acceptance Tests

Perform acceptance testing in accordance with RUS Bull 1753F-201 and as further specified in this section. Provide personnel, equipment, instrumentation, and supplies necessary to perform required testing. Notification of any planned testing shall be given to the Contracting Officer at least 14 days prior to any test unless specified otherwise. Testing shall not proceed until after the Contractor has received written Contracting Officer's approval of the test plans as specified. Test plans shall define the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested. Provide test reports in booklet form showing all field tests performed, upon completion and testing of the installed system. Measurements shall be tabulated on a pair by pair or strand by strand basis.

3.4.2.1 Copper Conductor Cable

Perform the following acceptance tests in accordance with TIA-758: a. Insulation Resistance b. Shorts/Crosses c. Grounds d. Opens e. Reversals f. Splits g. Transpositions h. Shield Continuity i. Loop Resistance j. Insertion Loss k. Capacitance 3.4.2.2 Fiber Optic Cable Test fiber optic cable in accordance ANSI/TIA/EIA-455-C and as further specified in

this section. Two optical tests shall be performed on all optical fibers: Optical Time Domain Reflectometry (OTDR) Test, and Attenuation Test. In addition, a Bandwidth Test shall be performed on all multimode optical fibers. These tests shall be performed on the completed end-to-end spans which include the near-end pre-connectorized single fiber cable assembly, outside plant as specified, and the far-end pre connectorized single fiber cable assembly.

a. OTDR Test: The OTDR test shall be used to determine the adequacy of the cable installations by showing any irregularities, such as discontinuities, 7 SECTION 33 82 00 Page 20 micro-bending or improper splices for the cable span under test. Hard copy fiber signature records shall be obtained from the OTDR for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in both directions. A reference length of fiber, 66 feet minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature. Conduct OTDR test and provide calculation or interpretation of results in accordance with TIA-526-7 for single-mode fiber. Splice losses shall not exceed 0.05db.

b. Attenuation Test: End-to-end attenuation measurements shall be made on all fibers, in both directions, using a 1310 and 1550 nanometer light source at one end and the optical power meter on the other end to verify that the cable system attenuation requirements are met in accordance with TIA-526-7 for single-mode fiber optic cables. The measurement method shall be in accordance with TIA-455-78-B. Attenuation losses shall not exceed 0.5 dB/km at 1310 nm and 1550 nm for single-mode fiber.

c. Power Source/Power Meter: This test shall consist of bi-directional, dual window (1300/1550nm) testing of every fiber strand installed.

3.4.3 Soil Density Tests

a. Determine soil-density relationships for compaction of backfill material in accordance with ASTM D1557, Method D.

b. Determine soil-density relationships as specified for soil tests in Section 31 00 00 EARTHWORK.

-- End of Section --