SECTION 27 00 00 – COMMUNICATIONS

PART I. GENERAL

[Note to AE: Coordinate this section with the other related Divisions. Some of the requirements listed in this Section need to be inserted in other Divisions within the Contract Documents.]

1.1 SUMMARY/OVERVIEW

A. This standard specifies requirements for telecommunications systems within and between buildings. It specifies a telecommunication system with a definite topology and required distances. It specifies media by parameters that determine performance to ensure interconnectivity.

B. *[Note to AE: Although the scope is limited only to the telecommunications aspect of building design, it should be recognized that the standard highly influences the design of other building services and also impacts space allocation within the building.]*

C. Telecommunications encompasses all forms of information transport and processing, including voice systems, data networks, video, control systems, security cameras, wireless, cellular, and audio. All are telecommunications ingredients of a modern building.

1.2 RELATED DOCUMENTS

A. *Drawing 27 00 00-1, Typical Outside Plant Distribution Diagram*

B. *Drawing 27 00 00-2, Telecommunications Typical Intrabuilding Elements*

C. *Drawing 27 00 00-3, Telecommunications Typical Wiring Schematic*

D. *Drawing 27 00 00-4, Telecommunications Typical Underground Building Entrances & Conduit Profiles*

E. *Drawing 27 00 00-5, Telecommunications Typical Trench Profiles*

F. *Drawing 27 00 00-6, Telecommunications Manhole Cover Detail*

G. *Drawing 27 00 00-7, Telecommunications U of I Logo Manhole Cover Detail*

H. *Drawing 27 00 00-8, Telecommunications Manhole Cover Frame Detail*

I. *Drawing 27 00 00-9, Telecommunications Typical 12' x 6'x 7' "J" Manhole Elevation*

J. *Drawing 27 00 00-10, Telecommunications Typical 12' x 6'x 7' "J" Manhole - Interior View*

K. *Drawing 27 00 00-11, Telecommunications Emergency Phone*

L. *Drawing 27 00 00-12, Telecommunications Emergency Phone - Flush Mount Bezel*

M. *Drawing 27 00 00-13, Telecommunications Emergency Phone With Exterior Enclosure*

N. *Drawing 27 00 00-14, Telecommunications Emergency Phone Kiosk*

O. *Drawing 27 00 00-15, Telecommunications Emergency Phone Base*

P. *Drawing 27 00 00-16, Telecommunications Typical Intermediate Distribution Frame (IDF)*

Q. *Drawing 27 00 00-17, Telecommunications Typical IDF Wall Layout*

R. *Drawing 27 00 00-18, Telecommunications Ground Bus Detail*

S. *Drawing 27 00 00-19, Telecommunications Typical Communications Equipment Room (CER)*

T. *Drawing 27 00 00-20, Telecommunications Typical Communications Equipment Room (CER) - With Stand Alone Air Conditioner*

U. *Drawing 27 00 00-21, Telecommunications Floor Distribution Frame (FDF)*

V. *Drawing 27 00 00-22, Telecommunications Typical Patch Panel Frame*

W. *Drawing 27 00 00-23, Telecommunications Typical Patch Panel*

X. *Drawing 27 00 00-24, Telecommunications Cable Tray Sizing Chart*

Y. *Drawing 27 00 00-25, Telecommunications Typical Station Outlet*

Z. *Drawing 27 00 00-26, Telecommunications Cable Identification in FDF*

AA. *Drawing 27 00 00-27, Telecommunications Recessed Floor Station*

BB. *Drawing 27 00 00-28, Telecommunications Typical Station Outlet For Modular Furniture*

CC. *Drawing 27 00 00-29, Telecommunications Typical Wall Phone*

DD. *Drawing 27 00 00-30 Telecommunications Wireless Access Point (WAP) - Above Ceiling*

EE. *Drawing 27 00 00-31 Telecommunications Wireless Access Point (WAP) - Below Ceiling*

FF. *Drawing 27 00 00-32, Telecommunications Pull Box Schedules*

GG. *Drawing 27 00 00-33, Telecommunications Sleeves & Conduits Through Floor*

HH. *Drawing 27 00 00-34, Station Cable Conduit Sizing*

II. *Drawing 27 00 00-35, Telecommunications Typical Below Ceiling Cable Tray*

JJ. *Drawing 27 00 00-36, Telecommunications Typical Station Outlet Identification*

KK. *Drawing 27 00 00-37, Telecommunications PIN Configurations For Voice/Data Jacks*

1.3 REFERENCES

A. Wiring standards will follow *EIA/TIA-568*, Commercial Building Wiring Standard Electronic Industries Association and Telecommunications Industry Association (EIA/TIA).

B. Pathways and equipment spaces will follow *EIA/TIA-569, Commercial Building Standard for Telecommunications Pathways and Spaces*.

C. Cable and wire placement and installation will follow the *Telecommunications Distribution Methods Manual*, Building Industry Consulting Services International (BICSI).

D. All conduit placement and installation will follow the *National Electrical Code (NEC).*

E. All work and materials will comply with all Federal and State laws, municipal ordinances, codes, regulations, and direction of inspectors appointed by proper authorities having jurisdiction.

F. Part 68-FCC rules will apply for telecommunications equipment and system.

G. The Section entitled *Codes, Regulations and Standards* in the *U of I Facilities Standards* shall also apply to this Section.

H. *Manual on Uniform Traffic Control Devices*, U.S. Department of Transportation

I. *American Disabilities Act*

J. *Illinois Accessibility Standards*

1.4 SYSTEM DESCRIPTION

A. The telecommunications system is a combination of twisted pair copper conductor-standard voice and data cable, fiber optic cable, coaxial cable, protectors, station jacks, terminating hardware, racks, wire management panels, surge protectors, patch panels, equipment rooms, wireless devices, antennas, security cameras, digital signage, and active network hardware.

B. The system is connected to the AT&T, Central Office (CO) through 10 separate Main Distribution Frames (MDF), referred to as Node Sites. See *Drawing 27 00 00-1, Typical Outside Plant Distribution Diagram*.

C. Each MDF is interconnected to a group of buildings, and each building has an Intermediate Distribution Frame (IDF). The IDF is interconnected to each floor of a building typically through a Floor Distribution Frame (FDF) or a Communications Equipment Room (CER).

D. *[Note to AE: All rooms shall have a minimum of 1 voice and data outlet.]* All station jack wiring is terminated at the FDF or CER.

E. *[Note to AE: A typical complete voice circuit shall consist of a voice jack wired through the FDF; the FDF wired through the IDF; the IDF wired to the MDF; and the MDF wired back to AT&T's Central Office (CO). A typical complete data circuit shall consist of a data jack wired back to a CER. More than 1 CER per building may be required.]* See *Drawing 27 00 00-2, Telecommunications Typical Intrabuilding Elements*.

1.5 SUBMITTALS

A. Submit shop drawings and product data under the provisions of *Section 01 33 23 – Shop Drawings, Product Data, and Samples*.

B. Product Data Submittal: Provide manufacturer's technical product specification sheet for each individual component type. Submitted data shall show the following:

1. Compliance with each requirement of these documents.

2. All component options and accessories specific to this Project.

3. Manufacturer's installation instructions.

1.6 QUALITY ASSURANCE

A. Minimum qualifications for Telecommunications Contractors are:

1. A BICSI Registered Communications Distribution Designer (RCDD) on staff.

2. 5 years experience in the Telecommunications industry.

3. 3 years working experience with outside plant construction, building copper and fiber optic cable installation, and large PBX installations of 1,000 stations minimum.

4. Experience installing distribution cables of 300 to 1800 pairs of various types.

5. Experience in a campus environment.

6. Ability to read and interpret construction drawings and specifications.

7. Familiarity with Northern Telecom BIX Cross-Connect System, and associated hardware.

8. Ability to produce cable test records, and record drawings.

9. The CITES Telecommunications Project Manager will review and approve the qualifications of all Contractors and Sub-Contractors to provide telecommunications services.

1.7 DEMOLITION

A. No telecommunications jacks, cabling, terminals, or other hardware shall be moved, disconnected, or removed without prior approval of the CITES.

B. Coordination of demolition activities with the department will be strictly enforced to minimize service disruptions.

C. Upon receipt of a Telecommunications Service Request (TSR), CITES will dispatch a technician within 24 hours to the requested work location. The technician will disconnect telecommunications service and all associated connections and cables. Under NO circumstances shall removal of telecommunications infrastructure and wiring facilities begin until the CITES has removed them from workstation outlet and terminal cabinet.

D. Wire mold that has been vacated, or otherwise determined not required, shall be removed after all cabling has been properly removed.

1.8 SEQUENCING-SCHEDULING

A. If it is necessary for a Contractor to make the connections to any University facility already in service, the Contractor shall request a date for making such connection at least 24 hours in advance so that the University can coordinate the timing and information to preclude an adverse impact on on-going operations.

1.9 WARRANTY

A. The University shall warrant all equipment, material, cable and workmanship for a minimum period of 2 years following acceptance.

B. During the warranty periods, the Contractor shall repair or replace any defective item at no cost to the University.

1.10 OWNERS INSTRUCTIONS TO CONTRACTORS

A. If there are violations of codes, the vendor shall correct the deficiency at no cost to the University.

B. Working conditions shall meet the industry standards for safety and work procedures, and protection of property established by prevailing rules, regulations, codes, and ordinances.

C. The F&S Division and CITES has drawings of existing University owned and underground utilities and provides locator service. Contractors are required to call JULIE SERVICES 1-800-892-0123 prior to digging for locating all utilities. However, the Contractor shall be responsible for locating and protecting all utilities, private and public.

D. The Contractor shall cooperate with the University and maintain access to all areas required by the University. The vendor shall be liable for all damages suffered by the University resulting from Contractor's negligence or lack of cooperation.

E. The cable plant distribution system shall be complete in every respect, constructed in accordance with generally accepted, current standard practices of the telecommunications industry and the detailed requirements of this Standard. It shall be ready to operate in the manner expressed or implied herein, regardless of whether or not full details of such completeness or practices are contained herein.

F. Workmanship and neat appearance shall be as important as the mechanical and electrical efficiency of the system.

G. Contractors shall be responsible for replacing, restoring, or bringing to at least original condition any damage to floors, ceilings, walls, furniture, grounds, pavement, etc., caused by its personnel and operations. Any damage or disfiguration will be restored at the Contractor's expense.

H. Contractors shall be responsible for ensuring minimal disruption of existing video, voice and data communications networks facilities, for all out of service and damage cases caused by their employees or firm, and will be billed by the University for repairs to facilities.

I. CITES has drawings detailing existing in-building cable runs, CERs, FDFs, terminal cabinets/closets, riser cables, etc. Copies may be obtained from CITES Engineering.

J. Outages shall be scheduled only with permission from CITES, and at its convenience.

K. Unless otherwise expressly provided in the Contract:

1. Any provision of the standard specifications which require the University to inspect certain material or work shall mean that the University has the option, rather than the obligation, to do so.

2. Any warranty or guarantee provisions contained in the Contractor's standard specifications shall be of no effect and the warranty and guarantee provisions, if any, of the Contract shall apply.

L. All work areas shall be cleared of all litter, and properly disposed of by Contractor on a daily basis.

M. Vendors shall provide all necessary temporary equipment and material, shall maintain them in a safe and adequate manner, and shall remove them immediately upon completion of Work requiring their presence.

N. **GPS Data Collection**: The contractor shall contact the Facilities & Services project representative a minimum of 24 hours prior to backfilling any underground utility installation exterior to the building including excavation for maintenance and/or repair of an existing utility for the purpose of GPS data collection.

1.11 DOCUMENTATION

A. Refer to *Section 01 78 39 - Project Record Documents* for additional requirements.

B. Documentation will consist of Cable Records, Test Records and Record Drawings prepared by the Contractor. They may be submitted in either of the following 2 formats:

1. AutoCAD compatible drawing files scaled to the true dimensions of the building AutoCAD Release 2007 drawings are preferred; however a minimum of Release 2004 will be accepted.

2. On reproducible media scaled no smaller than 1/8"= 1'- 0".

C. Cable Records: Contractor shall establish complete and accurate cable records showing every splice and cross-connect by cable number and pair number, jack number, and station location. These records shall conform to the cable numbering system established by the University.

D. Test Records: Contractor shall test every fiber and pair in every cable installed in accordance to section 3.1-D ACCEPTANCE TESTING. CITES will provide blank Test Record forms. A copy of the completed test record will be furnished to CITES.

E. As-Built Drawings: Contractor shall prepare and submit the as-built drawings of the completed outside plant infrastructure and inside plant infrastructure with marked up drawings prepared by the AE.

F. Record Drawings: Contractor shall prepare and submit record drawings that conform to the grid system used by the University. The Contractor shall add the distribution cabling system and show as a minimum:

1. Exact route of all Outside Plant from the MDF to the IDF's, including conduit and buried cable routes.

2. Cable type, size, count, gauge, and length of all cables placed.

3. Every splice by cable number and pair count.

4. The cable numbering system shall conform to the existing number system.

5. Depth of cable trench

G. In addition, Contractor will prepare and submit record floor plan drawings, which will include as a minimum:

1. IDF and FDF terminal locations.

2. Riser drawings showing corrected terminal locations, splice locations, and conduit sizes.

H. Mark drawings to record actual installation of:

1. Field dimensions, elevations and details.

2. Changes made by modification.

3. Details not on original drawings.

4. Depths of various elements of Work in relation to the Project data.

PART 2. PRODUCTS

2.1 OUTSIDE PLANT INFRASTRUCTURE

A. Main Distribution Frames

1. *[Note to AE: Drawing 27 00 00-4, Telecommunications Typical Underground Building Entrances & Conduit Profiles is included to illustrate and clarify Outside Plant (OSP) standards. Where applicable, it shall be reproduced in the Contract Drawings with modifications as necessary to comply with the given Project.]*

B. Conduit

1. *[Note to AE: Drawing 27 00 00-5, Telecommunications Typical Trench Profiles is included to illustrate and clarify Outside Plant (OSP) standards. Where applicable, it shall be reproduced in the Contract Drawings with modifications as necessary to comply with the given Project.]*

2. *[Note to AE: For all proposed underground facilities specify:*

a. *Duct size, material, number and formation, and location.*

b. *Depth of placement.*

c. *Selected backfill and cover.*

d. *Allowable number of turns and bends.*

e. *Radius factor of turns and bends]*

3. Underground conduit structures shall be encased in concrete.

4. Provide a polypropylene, twisted yellow, rot and mildew resistant, pull rope in all conduits. Minimum size is 3/8 inch O.D., with a 2400-pound tensile strength.

5. All underground conduit structures shall be Schedule 30, Class C Commercial Telephone Duct (OD 4.35 inch and ID 4 inch). 20 foot length, or approved equivalent *[Note to AE: List 2 additional Owner-approved manufacturers.]* shall be used for underground conduit structures, and belled at one end, with high tensile strength, preformed spacers, and placed at or near joints no more than 10 feet apart to keep ducts uniformly separated.

6. Install in at least 1 conduit a Conduit Measuring Tape (tape width 1/4-inch, test strength 800 pounds) that is water proof with permanent printed footage. Shall be able to be pulled in or back easily with standard rodding retrieval systems.

C. Manholes

1. Precast, equipped with factory installed terminators, necessary collars, sump with grate cover, pulling eyes opposite each duct entrance, frames and complete hardware package including ladders in manholes. Shall conform to specifications

of concrete products manufactured by Utility Concrete Products, Incorporated, Plainfield, Illinois.

2. *[Note to AE: The following typical diagrams, details and equipment schedules are included to illustrate and clarify Outside Plant (OSP) standards. Where applicable, they shall be reproduced in the Contract Drawings with modifications as necessary to comply with the given Project.]* All manholes must meet the specifications of the following drawings:

   a. *Drawing 27 00 00-6, Telecommunications Manhole Cover Detail*

   b. *Drawing 27 00 00-7, Telecommunications U of I Logo Manhole Cover Detail*

   c. *Drawing 27 00 00-8, Telecommunications Manhole Cover Frame Detail*

   d. *Drawing 27 00 00-9, Telecommunications Typical 12' x 6'x 7' "J" Manhole - Elevation*

   e. *Drawing 27 00 00-10, Telecommunications Typical 12' x 6'x 7' "J" Manhole - Interior View*

3. The standard size for manholes used with major underground conduit structures shall be 6 feet wide by 12 feet by 7 feet high. *[Note to AE: Alternate sizing permitted with CITES Project Manager's approval.]*

4. Manholes with knock windows for duct entrances will not be permitted.

D. Copper Cable/Splices

1. A backbone cable shall be standard exchange type telephone cable, which is defined as paired, multi-conductor, thermoplastic insulated, copper cable characterized by a mutual capacitance at 1000 Hz of 0.083 microfarads per mile. All cable provided shall be solid annealed copper.

2. Only 24 AWG cable shall be used in the distribution network, and shall be based on standard resistance design procedures, taking into account the signaling limits of the switching equipment. Loop resistance calculations shall be based on cable temperature of 68 degrees F. Cable selection shall be equivalent or better than AT&T products coded PIC, ASP, AFMW and ARMM as specified. *[Note to AE: List 2 additional Owner-approved manufacturers.]*

3. Cable selection shall be in accordance with the following selection chart:

   a.

APPLICATION	COND INSULATION	CORE	SHEATH
Distributing Frame Terminating Stubs	SOLID	AIR	ALVYN
Inter-building cable (Direct Buried)	FOAM/SKIN	FILLED	ASP *
Inter-building cable (In Conduit)	FOAM/SKIN	FILLED	ALPETH*

   b. **The National Electric Code (NEC)* prohibits the use of outside plant copper telephone cables within the building, since they are not fire-resistant and do not pass any of the fire tests. If these cables are utilized within a building

beyond a 10-foot distance from the building cable entrance, they shall be enclosed in heavy-duty metal conduit.

4. Cable shall be sized for 2 ½ times the quantity of voice stations and miscellaneous circuits specified by the end user and CITES.

5. Multiple appearances of cable counts in distribution terminals are not permitted.

6. Distribution (backbone) cables, from the node MDF to the building IDF, shall be equipped with protector modules at both ends of the cables (MDF and IDF).

7. Preformed splice cases or University approved equivalent *[Note to AE: List 2 additional Owner-approved manufacturers.]* shall be used for splicing throughout the underground system.

8. All splices in manholes shall be encapsulated. Re-enterable polyurethane compound shall be used in accordance to manufacturer's specifications.

E. Fiber Optic Cables/Splices/Terminations

1. The single mode underground campus backbone fiber optic cable shall be manufactured by Corning Cable Systems. The specifications represent a gel free, loose tube cable with a dielectric central member, single polyethylene jacket. It has an engineered loss of .4/.3 db/KM for 1310/1550 nanometer operation. Substitutions will not be allowed. *[Note to AE: Contact Owner in regard to the Capital Project Brand Name Policy.]*

2. The multi-mode underground campus backbone fiber optic cable shall consist of 62.5/125 micron graded index multimode fiber optimized for 1300 nanometer operation manufactured by Corning Cable Systems. The specifications represent a gel filled, loose tube cable with a dielectric central member, single polyethylene jacket. It has an engineered loss of 3.5 db/KM at 850-nanometer operation with a bandwidth of 200 MHz and 1.0 db/KM at 1300 nanometer operation with a 500 MHz bandwidth. Substitutions will not be allowed. *[Note to AE: Contact Owner in regard to the Capital Project Brand Name Policy.]*

3. Preformed splice cases or University approved equivalent shall be used for splicing throughout the underground system.

4. Fiber optic cables with 48 strands of fiber or less shall be terminated at the building shall utilize Ortronics Surface Mount Cabinet model OR-615SMFC-48p/s (wall mounted) or Ortronics Rack Mounted Fiber Cabinet model OR-FC02U-C. *[Note to AE: Contact Owner in regard to the Capital Project Brand Name Policy.]* Multimode fiber will be terminated with ST ultra polished connectors (UPC) duplex connectors and adapter panels. Single mode fiber will be terminated with SC ultra polished connectors (UPC) duplex connectors and adapter panels.

   a. Single Mode Adapter Panels OR-OFP-SCD12AC

   b. Multimode Adapter Panels OR-OFP-STD12MB

5. Fiber optic cables with more than 48 strands of fiber shall be terminated at the building shall utilize Corning Fiber Optic Termination Housing model CCH-04U and Splice Housings model CSH-03U. Mulitmode fiber will be terminated with ST ultra polished connectors (UPC) duplex connectors and adapter panels. Single mode fiber will be terminated with SC ultra polished connectors (UPC) duplex connectors and adapter panels.

   a. Single Mode Adapter Panels CCH-CP12-59

b. Multimode Adapter Panels CCH-CP12-15T

6. All fiber optic cables terminated in the node sites shall utilize Corning Cable Systems Cable Management Components including the Closet Distribution Frame (CDF) model CDF-ER-7A-19, Fiber Optic Termination Housing model CCH-04U and Splice Housings model CSH-03U. Mulitmode fiber will be terminated with ST duplex connectors and adapter panels. Single mode fiber will be terminated with SC ultra polished connectors (UPC) duplex connectors and adapter panels.

F. Emergency Telephones

1. The telephone approved for Campus-wide use in all elevators, Areas of Rescue Assistance (ARA), and outdoor locations is manufactured by the RamTel Corporation, 87 Putnam Pike, Johnston, Rhode Island 02919, (401) 231-3340. No substitutions will be permitted. *[Note to AE: Contact Owner in regard to the Capital Project Brand Name Policy.]* See *Drawing 27 00 00-11, Telecommunications Emergency Phone.*

2. The specified unit is RamTel's Model R-833 with a one-button, "off-hook" connection to a dedicated telephone station for the building. Additional features required for the unit to perform in the University system are:

a. A dial answering module which automatically answers incoming calls in an emergency.

b. A telephone disconnect module (disconnects the telephone automatically) after a pre-set time, if no conversation is ongoing with the police department.

c. For flush mounted phones, a mounting bezel (Model No. 906) is required. See *Drawing 27 00 00-12, Telecommunications Emergency Phone Flush Mount Bezel*.

d. If surface mounting is necessary, an enclosure is required. To order; following Model No. R1C-S, add-901-W(R). See *Drawing 27 00 00-13, Telecommunications Emergency Phone with Exterior Enclosure*.

G. Outdoor Kiosk

1. The enclosure selected by the University to be the standard for the U of I campus is manufactured by King Products Limited (3150 Whorton Way, Mississauga, Ontario, Canada, L4X2C1, and telephone number (416) 625-1111). The unit is considered a sole source item (See *Drawing 27 00 00-14, Telecommunications Emergency Phone Kiosk and Drawing 27 00 00-15, Telecommunications Emergency Phone Base)*. *[Note to AE: These kiosks can be purchased from CITES for Projects if necessary.]*

2. The enclosure is the KING J-072 telephone kiosk, finished black anodized aluminum with a front lens. This model is designed to house and protect the emergency telephone unit with a minimum structure.

3. The enclosure requires a timed 115/AC electrical connection in addition to the telephone line (2 conduits).

4. See *Drawing 27 00 00-15, Telecommunications Emergency Phone Base* for the emergency phone concrete base. A full size template is available from CITES.

H. Documentation

1. Contractor shall provide product information for University approval prior to ordering materials. *[Note to AE: Coordinate with Owner. This may be an Owner-provided, Contractor-installed item.]*

2.2 INSIDE PLANT INFRASTRUCTURE

A. Intermediate Distribution Frame (IDF)

1. All new building structures shall have 1 Intermediate Distribution Frame (IDF).

2. The IDF is the component of the building entrance facility that provides space for the termination of Outside Plant (OSP) and Inside Plant (ISP) cable. It may contain network interface devices and the telecommunications data equipment.

3. Because of the variations in size, location, usage, and requirements, IDF sizes and locations shall be evaluated separately. The minimum dimensions for an IDF are 7'-0" by 4'-6". See *Drawing 27 00 00-16, Telecommunications Typical Intermediate Distribution Frame (IDF) and Drawing 27 00 00-17, Telecommunications Typical IDF Wall Layout*.

4. *[Note to AE: The following base minimum standards shall be included in planning entrance terminal locations]:*

a. The space shall be permanently located and not subject to changes due to building alterations or rearrangement of interior partitions, and be accessible from public corridors and spaces. If the space is not readily accessible to CITES employees, keys shall be available, even during off hours.

b. The IDF shall be located on the basement level as close as possible to the utility building entrance.

c. All ceiling heights shall be a minimum of 8 feet 6 inches unobstructed, doors shall be a minimum of 3 feet by 7 feet, open outward, and be equipped with a suitable lock.

d. The IDF shall be of adequate size to accommodate 50 percent future expansion of the equipment. This shall be determined by the AE.

e. The space allotted shall be dry and free from the danger of flooding. No exposed water, gas or steam pipes shall enter in or run through the IDF. No drains, ducts, or clean-outs are permitted. Any water, vent, gas or steam pipes entering this space shall be re-routed at no additional cost to the University.

f. The space shall be free of automatic fire sprinklers except as required by code. If required, the sprinklers shall be equipped with high temperature heads.

g. The space shall be free from hazards due to electrical or mechanical equipment.

h. The IDF shall be locked and keyed to the CITES C key.

i. A 4” x 10” Ground Bus connected to a #6 ground wire enclosed in a 1/2 inch conduit to the nearest approved metallic ground connection point shall be provided to a building ground GRID meggered less than 5 ohms. See *Drawing 27 00 00-18, Telecommunications Ground Bus Detail.* The floors, walls and ceilings shall be treated to eliminate dust. The space shall be free of false ceilings.

j. Lighting shall be a minimum of 50-foot candles measured 3 feet above the finished floor, in the middle of all aisles between cabinets and racks.

k. A dedicated 115-volt, 20-amp, grounded, non-switched, duplex receptacles, 1 per every 10 linear feet of wall space shall be provided, in addition to any required special circuitry and receptacles. Two dedicated 208-volt, 30-amp, grounded, non-switched, duplex receptacles shall be located on the wall adjacent to the equipment rack.

l. The closet walls shall be lined with fire retardant 3/4 inch plywood covering to a height of 8'-6". A minimum of two 4 feet by 8 feet sheets are required for each IDF.

1) Backboards: All backboards required in IDF shall be:

(i) Fire retardant plywood, 3/4 inch by 4 feet by 8 feet

(ii) Smooth one side

(iii) Installed with smooth side exposed

(iv) Backboards shall be installed so that the top is eight feet six inches (8' 6") above finished floor.

5. *[Note to AE: Elements of the IDF facilities design shall include the following]:*

a. Type, size, gauge, and sheath of distribution cables from the MDF to the IDF of the new/existing building.

b. Type and quantity of terminal hardware for the MDF and IDF.

c. Size, type and quantity of associated structures to support or house the cables and terminal hardware, such as:

1) Under floor conduit

2) Building entry conduit

3) Splices

4) Protectors

5) Frames

6) Racking

7) Cable trays

d. Location of cables and terminal hardware.

6. Materials:

a. Distribution frames and terminal hardware shall be the BIX Cross-Connect System, manufactured exclusively by Belden Inc. All frames and hardware shall be sized to accommodate initial requirements plus 25 percent growth. *[Note to AE: Contact Owner in regard to the Capital Project Brand Name Policy.]*

b. No substitutions are permitted for the following frames and terminal equipment:

1) Distribution Frame - AX102073

2) Mount - BIX12E

3) Distribution Connector (connecting block) - QCBIX1A

4) Multiplying Connector - QCBIX5A

5) Distribution Ring - QRBIX19A

6) Designation Strip - QSBIX200A

7) Wire Retainer - PO660798

c. Building Entrance Protectors shall be manufactured by Porta Systems Corp. Terminal hardware shall be sized to accommodate initial requirements plus 25 percent growth. The protector modules shall be solid state with a five pin heat coil over current protector. Substitutions will not be allowed. *[Note to AE: Contact Owner in regard to the Capital Project Brand Name Policy.]*

1) Building Entrance Terminals (BETs), Series 25 for 25 pair cables.

2) Building Entrance Terminals (BETs), Series 26 for 100 pair cables.

3) Building Entrance Terminals (BETs), Series 28 XLBET for 300 pair cables.

4) Solid State Primary Protection Modules #115SCG-300

d. Where additional frames are required, the new frames shall be butted to and aligned with the existing frames.

e. All frames shall be installed and grounded in accordance with the manufacturers and industry standard practices.

f. Telecommunications Contractor shall install MS2 modular, stackable connectors and provide 3M K&B type closure and other hardware required at the IDF and MDF. The distribution side shall be spliced to the shielded stubs of the protectors.

B. Communications Equipment Rooms (CER) *[Note to AE: Incorporate the following items into the design of the CER.]*

1. A Communications Equipment Room serves the space needs for larger telecommunications equipment (e.g., networking, computing or video equipment).

2. When selecting the CER site, attempt a central location; avoid locations that are restricted by building components that limit expansion. Accessibility for delivery of equipment to the room shall be provided. Accessibility from a public corridor or space is required.

3. The placement of CERs adjacent to building columns, elevator shafts, stairways, utility chases and exterior walls greatly restricts flexibility with regard to the layout of a raceway system and the subsequent routing of cables and is highly discouraged.

4. In large buildings, the floor areas shall be "zoned" to assist in the planning of the communications support facilities. Sufficient CERs shall be provided and properly located to limit station wiring runs to 250 cable feet maximum. This requirement shall dictate such zones.

5. The minimum dimensions for a CER are 8 feet by 10 feet. However, this shall not be considered the final design unless they have been reviewed and deemed adequate by CITES. See *Drawing 27 00 00-19, Telecommunications Typical Communications Equipment Room (CER)*. If a dedicated air conditioner is required to serve the CER, the size of the room shall be enlarged to accommodate the unit. See *Drawing 27 00 00-20, Telecommunications Typical Communications Equipment Room (CER) With Stand Alone Air Conditioner*.

6. The standard 8' x 10' CER is designed to include no more than two (2) equipment racks. Each rack shall be equipped with no more than five (5) 48 port patch panels. High density patch panels will not be accepted. Any CER serving more than 480 data connections shall be enlarged to accommodate additional equipment racks.

7. CER shall be connected to IDF or FDF via conduit or cable tray.

8. All rooms shall be free of all safety hazards, the danger of flooding and suspended ceilings except where required for fire resistive rating.

9. The room shall be located away from sources of electro-magnetic interference at a distance that will reduce the interference to 3.0 V/m throughout the frequency spectrum.

10. The space allotted shall be dry and free from the danger of flooding. No exposed water, gas, steam pipes, electrical conduits, chilled water lines or HVAC ducts shall enter in or run through the IDF or a CER. No drains, clean-outs, electrical conduits, chilled water lines or HVAC ducts are permitted. Any water, vent, gas or steam pipes entering this space shall be re-routed at no additional cost to the University.

11. HVAC shall be included in the design of the equipment room to maintain a constant temperature 24 hours a day. When active devices (heat producing equipment) are present, a sufficient number of air changes shall be provided to dissipate the heat. A minimum of 1 complete air change per hour is required.

12. Each CER requires a dedicated 100 amp sub-panel for electrical service located within the CER. Only circuits terminating in the CER shall be managed from the CER sub-panel. Sub-panels shall provide a minimum of two phases to provide for 208/240 VAC.

13. Sub-panel feeder shall be NEC code. In order to provision for harmonic loads present in network equipment, feeder neutrals shall be sized at 150% the current rating of the hot conductors.

14. A dedicated 115-volt, 20-amp, grounded, non-switched, duplex receptacles, 1 per every 10 linear feet of wall space shall be provided, in addition to any required special circuitry and receptacles. Two dedicated 208-volt, 30-amp, grounded, non-switched, duplex receptacles shall be located on the wall adjacent to the equipment rack. Receptacles shall be connected to emergency power sources, if available.

15. A 4" x 10" Ground Bus connected to a #6 ground wire enclosed in a 1/2 inch conduit to the nearest approved metallic ground connection point shall be provided to a building ground GRID meggered less than 5 ohms. See *Drawing 27 00 00-18, Telecommunications Ground Bus Detail.*

16. The closet walls shall be lined with fire retardant 3/4 inch plywood covering to a height of 8'-6". A minimum of two 4 foot by 8 foot sheets are required for each CER.

    a. Backboards-All backboards required in CER shall be:

        1) Fire retardant plywood, 3/4 inch by 4 feet by 8 feet.

        2) Smooth one side.

        3) Installed with smooth side exposed.

        4) Backboards shall be installed so that the top is 8'- 6" above finished floor.

17. Lighting shall be a minimum of 50-foot candles measured 3 feet above the finished floor, in the middle of all aisles between cabinets and racks.

18. The CER shall be locked and keyed to the CITES C key.

C. Floor Distribution Frames (FDF) *[Note to AE: Incorporate the following items into the design of the FDF.]*

1. Floor Distribution Frame (often more than 1 per floor) may be defined as rooms or shallow enclosures that are normally accessible through a door or series of doors hinged to open outwards. The floor closets shall be designed to accommodate the following: riser cables from the riser system, cables to interconnect closets when there are more than 1 per floor, frames, apparatus racks, station cables, mounting boards and terminating blocks. Size of riser cables, conduits and location of closets on each floor shall be determined after station distribution is decided in multi-level structures. FDF closets shall be stacked one above another.

2. In new buildings, the FDF shall be combined with the CER in one room to provide voice and data service. FDFs in existing buildings provide voice service only. Sufficient FDFs shall be provided and properly located to limit station wiring runs to 250 cable feet maximum.

3. The minimum dimensions for a FDF are 5'-6" deep by 8'-0" wide. However, this shall not be considered the final design unless they have been reviewed and deemed adequate by CITES. See *Drawing 27 00 00-21, Telecommunications Floor Distribution Frame (FDF)*.

4. The closet walls shall be lined with fire retardant 3/4 inch plywood covering to a height of 8'-6". A minimum of two 4 foot by 8 foot sheets are required for each FDF.

    a. All backboards required in FDF shall be:

        1) Fire retardant plywood, 3/4 inch by 4 feet by 8 feet.

        2) Smooth one side.

        3) Installed with smooth side exposed.

        4) Backboards shall be installed so that the top is 8'- 6" above finished floor.

5. 3M brand K&B building riser closures or University approved equivalent *[Note to AE: Include 2 additional Owner-approved manufacturers]* shall be used in building locations requiring a closure of 4 inches in diameter or less. All closures and end-caps shall be flame retardant.

6. Minimum ceiling height is 8'-6".

7. All closets shall be located to open into public areas, i.e. hallways, for unrestricted access by CITES personnel. Access to closets through offices or mechanical rooms is not permitted.

8. FDF's which house pieces of communications equipment hardware, riser cable and station wiring terminations, shall be located away from sources of electro-magnetic interference at a distance which will reduce the interference to 3.0 V/m throughout the frequency spectrum.

9. All rooms shall be free of all safety hazards, the danger of flooding and suspended ceilings except where required for fire resistive rating.

10. The space for station cable terminations shall be located on 1 continuous wall.

11. All floor/riser closets shall be equipped with a minimum of 1 non-switched 115 volt, 20 amp, grounded, separately fused duplex receptacle. Duplex receptacles shall be connected to emergency power sources, if available.

12. Overhead lighting shall be equivalent to at least 50 foot candles.

13. The closets shall be locked and keyed to the CITES C key.

D. CER and FDF Copper Terminations

a. Copper cables (riser and horizontal/station) terminated at the CER or FDF for voice communications shall utilize the BIX Cross-Connect System, manufactured exclusively by Belden Inc. and sized to accommodate initial requirements plus 25 percent growth. . *[Note to AE: Contact Owner in regard to the Capital Project Brand Name Policy.]*

b. No substitutions are permitted for the following frames and terminal equipment:

1) Mount - BIX12E

2) Distribution Connector (connecting block) - QCBIX1A

3) Distribution Ring - QRBIX19A

4) Wire Retainer - PO660798

5) Designation Strip - QSBIX200A

c. Copper cables (horizontal/station) terminated at the CER for data communications shall utilize equipment frames and patch panels manufactured exclusively by Ortronics of New London, CT 06320, 1-800-934-5432. No substitutions are permitted for the following equipment: See *Drawing 27 00 00-22, Telecommunications Typical Patch Panel Frame and Drawing 27 00 00-23, Telecommunications Typical Patch Panel.* . *[Note to AE: Contact Owner in regard to the Capital Project Brand Name Policy.]*

1) Mighty Mo 10 Wire Management Rack with a 16 ½" channel depth, 7' high with 45 rack units - OR-MM10716

2) Category 6, 24 Port Panel - OR-PSD66U24

3) Category 6, 48 Port Panel - OR-PSD66U48

4) Wire Management Panel - OR-808004818

E. Raceways

1. Conduit

a. Conduit provided for all communication wiring shall be color coded blue for identification.

b. Riser conduit runs for distribution cables (both horizontal and vertical), except station outlets, shall be not less than 4 inches trade size. Provide a polypropylene, twisted yellow, rot and mildew resistant, pull rope in all conduits. Minimum size is 3/8 inch O.D., with a 2,400 pounds tensile strength.

c. All conduit runs for station outlets shall be 1-inch trade size or larger as required. Total length of a conduit run shall not exceed 150 feet, including the distance through pull boxes. The conduit shall be equipped with a plastic or nylon pull line that is rated at 200 pounds test.

2. Cable Trays

a. All cable trays must be approved by the University prior to their inclusion in drawings and specifications. Wall mounted cable trays placed below the ceiling are preferred to cable trays placed above ceilings. Cable trays placed above ceilings shall be placed in non-restricted, public areas, i.e. hallways. Cable trays placed above office ceilings are not permitted.

b. Ladder type cable trays, utilizing only flat or round rungs are permitted. Diamond shaped rungs are prohibited. Maximum allowable distance between rungs on ladder type trays is 9”.

c. Wire basket cable trays shall consist of continuous, rigid, welded steel wire mesh and will have continuous T-welded top side wire to protect cable installation and installers. Flextray, manufactured by GS Metals, and associated accessories are an approved product.

d. Standard cable trays shall have an electroplated zinc coated finish.

e. Cable trays for horizontal distribution cables, utilizing the trapeze hanger method to support the cable trays, shall utilize threaded rods of not less than 1/2 inch in diameter. Center hung supports will not be allowed. Cable trays shall be installed per the manufacturer’s specifications.

f. Cable trays shall be sized for a 40% fill ratio of total fill capacity, plus an additional 50% to allow for growth and future cabling changes. See *Drawing 27 00 00-24, Telecommunications Cable Tray Sizing*.

3. Communication Outlet Boxes

a. Typical station jack wall outlets shall be zinc-coated or cadium plated sheet steel outlet boxes measuring 4 inch by 4 inch by 2-1/8 inches deep, with a double gang plaster ring. Boxes shall be 1 piece stamped sheet steel. No spot welding or riveting will be permitted.

b. Station jack wall outlets designated as wall telephones or wireless access points shall be zinc-coated or cadium plated sheet steel outlet boxes measuring 4 inch by 4 inch by 2-1/8 inches deep, with a single gang plaster ring. Boxes shall be 1 piece stamped sheet steel. No spot welding or riveting will be permitted.

F. Transmission Media

1. Copper Riser Cable

a. A backbone cable shall be standard exchange type telephone cable, which is defined as paired, multi-conductor, thermoplastic insulated, copper cable characterized by a mutual capacitance at 1000 Hz of 0.083 microfarads per mile. All cable provided shall be solid annealed copper.

b. Only 24 AWG cable may be used in the distribution network, and shall be based on standard resistance design procedures, taking into account the signaling limits of the switching equipment. Loop resistance calculations shall be based on cable temperature of 68 degrees F. Cable selection shall be air core, solid conductor insulation with an ALVYN sheath and shall be equivalent or better than AT&T products coded PIC, ASP, AFMW and ARMM as specified. *[Note to AE: List 2 additional Owner-approved manufacturers.]*

2. Horizontal/Station Cable

a. Only 23 AWG cable shall be used in the distribution network, and shall be based on standard resistance design procedures, taking into account the signaling limits of the switching equipment. Loop resistance calculations shall be based on cable temperature of 68 degrees F.

b. A minimum of 2 station cables shall be installed for each telecommunications outlet. 1 will be used for voice service, the other for data. (See *Drawing 27 00 00-25, Telecommunications Typical Station* for cable terminations to modular jacks.

c. The minimum data transmission performance level for all station cables shall be a Category 6e, 4 pair twisted, 23 AWG solid copper, NEC rated CM flame retardant polyethylene insulation, rip cord, and have a PVC jacket. Acceptable cable surface markings shall indicate: "Verified Level VI" or "Classified Level VI", ("LVL" or "LEV" may be substituted for "Level").

d. Specific locations or applications may require different cabling configurations.

e. 1 voice station cable shall be installed for each fire alarm circuit and wall mounted telephones.

f. Station cables for voice jacks shall have a blue jacket, shall terminate on the telephone jack (top/left) and shall be designated "Voice". See *Drawing 27 00 00-25, Telecommunications Typical Station*. Voice cables shall terminate in the FDF identified on the drawings on BIX connecting strips, designated "A" on the designation strip. See *Drawing 27 00 00-26, Telecommunications Cable Identification in FDF*.

1) Mohawk Wire and Cable Corp. - Non-Plenum M57202

2) Mohawk Wire and Cable Corp. - Plenum M57193

3) Brands that meet the same cable characteristics as the above. *[Note to AE: List 2 additional Owner-approved manufacturers.]*

g. Station cables for data jacks shall have an orange jacket, shall terminate on the data jack (bottom/left) and shall be designated "Data". See *Drawing 27 00 00-25, Telecommunications Typical Station Outlet*. Data cables shall terminate in the CER on Ortronics Category 6 patch panels. See *Drawing 27 00 00-23, Telecommunications Typical Patch Panel*.

1) Mohawk Wire and Cable Corp. - Non-Plenum M57208

2) Mohawk Wire and Cable Corp. - Plenum M57199

3) Brands that meet the same cable characteristics as the above. *[Note to AE: List 2 additional Owner-approved manufacturers.]*

h. 1 station cable shall be installed for each wireless access point.

i. Station cables for wireless access points and security cameras shall have a white jacket. The cables shall terminate in the CER on Ortronics Category 6 patch panels. See *Drawing 27 00 00-23, Telecommunications Typical Patch Panel*.

1) Mohawk Wire and Cable Corp. - Non-Plenum M56889

2) Mohawk Wire and Cable Corp. - Plenum M56905

3) Brands that meet the same cable characteristics as the above. *[Note to AE: List 2 additional Owner-approved manufacturers.]*

j. 1 pair (white/blue) for all voice jacks shall be cross-connected at the FDF and IDF to provide a continuous circuit back to the node site.

3. Fiber Optic Riser Cables

a. The multi-mode in-building fiber optic cable shall consist of 50/125 micron laser optimized fiber optimized for 850/1300 nanometer operation manufactured by Corning Cable Systems. It is designed for high performance laser-based 10 Gigabit Ethernet. It has an engineered loss of 3.0 db/KM at 850 nanometer operation with a bandwidth of 1500 MHz and 1.5 db/KM at 1300 nanometer operation with a bandwidth of 500 MHz. The minimum effective modal bandwidth is 2000 MHz. The specifications represent a MIC cable with a NEC rated CM flame retardant sheath designed for riser applications. Substitutions will not be allowed. . *[Note to AE: Contact Owner in regard to the Capital Project Brand Name Policy.]*

b. The single mode in-building fiber optic cable shall be manufactured by Corning Cable Systems. The specifications represent a gel free, MIC cable, with a NEC rated CM flame retardant sheath designed for riser applications. It has an engineered loss of 1/.75 db/KM for 1310/1550 nanometer operation. Substitutions will not be allowed. . *[Note to AE: Contact Owner in regard to the Capital Project Brand Name Policy.]*

c. Plastic wire ties shall not be used with fiber optic cable. Velcro wire wraps shall be used to prevent excessive crimping of the fiber.

4. Coax

a. See CITES Engineering for video cable requirements.

G. Station Cable Termination

1. Faceplates configured with “snap-in” modules designed for voice and data shall be the ORTRONICS series, manufactured exclusively by ORTRONICS, 125 Eugene O'Neill Drive, New London, Ct 06320, telephone (800-934-5432). . *[Note to AE: Contact Owner in regard to the Capital Project Brand Name Policy.]* Excluding the provisioning of multi-media locations.

2. The following is a list of ORTRONICS Track Module components required to install a modular premise distribution system. It should not be considered as the complete product line for the ORTRONICS series.

    a. See *Drawing 27 00 00-25* and *Drawings 27 00 00-27* through *27 00 00-29* for typical voice/data outlets.

Telephone Voice Jack Category 6 (blue) -	OR-TJ600-36
Data Jack Category 6 (orange) -	OR-TJ600-43
Double Gang Faceplate -	OR-40300555-99
Single Gang Faceplate -	OR-40300546-99
Blank Filler -	OR-42100002-99
Duplex 106 for recessed floor outlets -	OR-40800017-99
Quad 106 for recessed floor outlets -	OR-40800019-99
Modular Furniture Faceplate -	OR-40300577
Surface Housing -	OR-40400054

3. Wall phone wall plates shall be stainless steel and include a 6 conductor jack with screw terminals. Approved model is Leviton #40226-S. . *[Note to AE: Contact Owner in regard to the Capital Project Brand Name Policy.]* See *Drawing 27 00 00-29.*

H. Wireless Communications

1. The campus wireless is based on IEEE 802.11a, b, g, n standards, also commonly known as WiFi.

2. *[Note to AE: Currently the 2.4 GHz and 5 GHZ ISM unlicensed frequencies are utilized to provide the service. Campus Wireless service has spectrum priority over any other wireless system on the Urbana campus. Placement of any device that transmits in either of the 2.4 GHz and 5 GHZ ISM bands must be coordinated with and approved by the CITES Networking. These include other WiFi systems, cordless phones, fixed Bluetooth systems, and Zigbee type products.*

3. *New buildings are required to provide full building wireless coverage. On remodeling projects, contact CITES Engineering for existing coverage.]*

4. All wireless radios shall be manufactured by Meru. Current models include MN-AP208, MN-AP311 for plenum areas, and MN-AP320i for exposed or non-plenum areas. . *[Note to AE: Contact Owner in regard to the Capital Project Brand Name Policy.]*

5. Station jack wall outlets designated for wireless access points shall be zinc-coated or cadium plated sheet steel outlet boxes measuring 4 inch by 4 inch by 2-1/8 inches deep, with a single gang plaster ring. A 1” conduit shall be installed from the outlet box to the cable tray.

6. Where possible, install wireless access outlets in hallways or public spaces, above suspended ceilings. A clear area of 24” is required around the outlet to provide space to mount the radio and antennas. See *Drawing 27 00 00-30, Telecommunications Wireless Access Point (WAP) Above Ceiling and Drawing 27 00 00-31, Telecommunications Wireless Access Point (WAP) Below Ceiling.*

PART 3. EXECUTION

3.1 OUTSIDE PLANT INFRASTRUCTURE INSTALLATION

A. Conduit and Manhole Placement

1. Manhole Work shall be performed by 2 or more workers, with 1 remaining above ground. Safety regulations shall be strictly adhered to.

2. Access to the manholes shall be coordinated with CITES engineers. 24 hour notice before entering a manhole shall be given.

3. Adequate manhole foundation shall be provided. Pre-cast base section shall be placed on a well-graded granular bedding course not less than 6 inches in thickness and extending to the limits of the excavation. The bedding course shall be firmly tamped and made smooth and level to ensure uniform contact and support.

4. Manholes will be installed level. The manhole frame and lid shall be flush with final finished grade. Grade rings (6 or 12 inch) with a galvanized step are required to anchor a ladder and to bring lid flush with grade.

5. All underground duct systems shall maintain a minimum of 24 inches ground cover throughout.

6. The existing underground duct systems shall be utilized where possible for on-campus distribution of cables to appropriate buildings.

7. Underground conduit shall be installed to those buildings not directly served by the existing duct system. Exceptions to this are those sites served by direct-buried outside plant.

8. Any unusual water seepage in manholes and apparent water leaks in main terminal rooms shall be reported promptly to the University on a daily basis.

9. Excavation

    a. The Contractor shall be required to do all the excavation for the installation of underground mechanical piping and performance of all auxiliary Work that may be required.

    b. At its own expense, Contractor shall erect temporary fencing where required or deemed necessary by the University to ensure safety of University personnel, students and visitors, or where deemed necessary by Contractor for securing materials.

    c. All trenching within public rights-of-way owned by or under the jurisdiction of the cities of Champaign or Urbana shall conform to the appropriate city's standards. The Contractor is responsible for obtaining cut and trench permits and for ensuring that the most current standards are met.

    d. Special care shall be taken to have all fire hydrants and gate valves on water main kept accessible at all times. To avoid possible major water utility outages, the F&S Division requires notification before any tee or elbow fitting on a water main 4 or more inches in diameter is exposed.

    e. The Contractor shall not obstruct the gutter of any street or driveway, but shall use all proper means to provide for the free passage of surface water along the gutters into storm water inlets. The Contractor shall provide channels where necessary.

    f. Pavement shall be saw cut at a full depth, in a straight line at a minimum of 1 foot on each side of trench width and 1 inch deep into concrete, if concrete base under asphalt pavement.

g. Walks and drives shall be saw cut at existing joints for replacement. Road patches that are near existing joints shall be extended to existing joints. New concrete shall be saw cut 1/3 of total thickness for joints and at intervals not to exceed 15 feet. These saw cuts shall be sealed with rubberized asphalt after cleaning.

h. The width of the trench shall be per the Construction Drawings. Where sheeting is required, this width shall be increased by the thickness of the sheeting.

i. Wherever necessary, the side of the trench shall be shored and braced in strict accordance to the rules, orders and regulations of the State of Illinois and OSHA.

j. Should the trenching be excavated to a greater depth than that given, the Contractor shall, at his own expense, bring such excavation to required grade with such material as directed, notwithstanding that it may be necessary to bring such material from other localities or to purchase suitable material.

k. Where groundwater or soft, yielding, or otherwise unsuitable material is encountered in the bottom of the trench, making it an unsuitable foundation for the pipe, such material shall be excavated from the full width of the trench to a satisfactory depth. Said depth shall be a minimum 6 inches. The resulting space shall be back-filled with imported bedding properly compacted to give adequate pipe support.

l. The material excavated shall be deposited along the side of the trench in such a manner as to create the least inconvenience possible.

m. Surplus earth from the trenches, after compacting, shall be removed and disposed of by the Contractor in a proper and legal location acquired by the Contractor or on University property, designated by the University.

n. All underground construction Work, during progress and after completion, shall conform to finish grades.

o. Major underground conduit structures shall be encased in concrete. Concrete encasement shall be a 5-bag mix with pea gravel aggregate and a 9-inch slump.

p. All mechanical piping shall be laid on a bed of clean, dry sand no less than 6 inches thick. The space between the pipe and the sides of the trench shall be filled with concrete to a point 6 inches above the crown of the pipe and both sides of the pipe shall be filled at the same time.

q. The remainder of the trench shall be back-filled with native soil in lifts no greater than 12 inches and shall be mechanically compacted by tamping to maintain a minimum relative density of 90 percent.

r. Any asphalt pavement cut shall be replaced and shall conform in kind and quality to the type of pavement removed, but in no case, is less than 12 inches of base rock to be placed beneath the pavement. Where plant mix or asphalt concrete surfacing exists, pavement shall not be less than 3 inches in thickness.

s. All concrete roads shall have expansion joints at intervals not to exceed 45 feet, with 1/2 inch wide joint material at least 6 inches deep. Expansion joints shall be placed between all new and existing concrete.

t. All new concrete pavements shall be a minimum of 6-bag mix with a minimum of 6 percent and a maximum of 8 percent air entrainment and 2 inch slump. New concrete to match existing surface or to be broom finished as desired by the Owner and is sloped for proper drainage. Concrete pavement shall conform to the requirements of the Cities.

u. All patches in roads and curbs shall be doweled with ½ inch by 18 inch smooth re-bar spaced not less than 18 inch intervals placed 9 inches into existing concrete. Portion of bar in new concrete shall be greased and paper wrapped.

v. Curing time with accelerator is 3 days; 7 days without. Traffic load may be delayed up to 14 days beyond cure period.

w. Field tests shall be conducted by the *[AE/Owner] [Note to AE: Insert the entity responsible for performing the tests for the specific Project]* to determine compliance of compaction methods with specified density in accordance with:

1) ASTM D2922 - Tests for density of soil and soil aggregate in place by nuclear methods,

2) ASTM D1556 - Tests for density of soil in place by the sand code method, or

3) ASTM D2167 - Tests for density of soil in place by rubber-balloon method.

x. Compaction shall be to the following minimum densities, reference ASTM D698 or AASHTO T99 unless otherwise indicated.

1) Sub grade: Under footings or foundation: 100%
All other locations: 95%

2) Barrier material: 95%

y. Pipe Bedding - Lightly compacted select soil: 80%
- Carefully compacted select soil: 90%
- Compacted granular material 80% (ASTM DO249)
- Barrier material: 95%

z. Trench Back Fill

1) State Highways - 100% for paved areas and shoulder slope
- 95% for all other areas

2) Paved Roadways, sidewalks and other areas to receive pavement.
Top four feet: 95%
Remainder of trench: 90%

3) Gravel Roadways: 90%

4) Sodded or lawn areas: 88%

5) Fields: 80% or equal to the density of undisturbed adjacent material whichever is greater unless otherwise indicated.

6) Under-footings, foundations or structures: 100%

7) All other locations: 95%

aa. Bricks, blocks and other debris removed from trenches shall not be used as fill for the trenches.

bb. Grass shall be replaced by a method approved by the University.

cc. Where granular materials are used in lieu of cohesive soils, reduce the above percentages by 15 percent to arrive at the relative density and ASTM D2049 shall apply.

dd. Moisture Content

1) Compact soils within (+) 2 percent of optimum moisture.

2) Add water, harrow, disc, lade or otherwise work material as required to ensure uniform moisture content specified.

10. Building Entrance Conduit

a. All new service entrance conduits shall be of 4 inch trade size. They shall provide a 25 percent growth capacity, and shall terminate in the IDF (main terminal room) inside the building.

b. The University standard requires that a minimum of 3 conduits enter major buildings, 1 to serve each media type (copper and fiber optic) including a spare for future growth. During the process of design and development drawings, CITES will specify the exact number of conduits entering the building based on the number of stations and/or a particular application.

c. Conduits entering the IDF through the wall shall be reamed and bushed, and terminated not more than 4 inches from the entrance wall.

d. Building entry conduits shall be 4 inch rigid steel conduit, extending 10 feet from the building foundation.

e. Provide 4 inch metal base, screw type adjustable plugs with expandable rubber outer surface in vacant conduits at both manhole and building entrance openings in the Main Terminal Room.

f. All cable filled conduits shall be sealed with 3M Fire Barrier 2001 Silicone RTV Foam conduit sealant manufactured by 3M Fire Protection Products, or approved equivalent, installed in accordance with the manufacturer's tested methods.

g. Conduits entering the IDF from below shall be terminated 4 inches above finished floor.

B. Cable Placement

1. Copper: The following standards relative to pulling telecommunication cables into conduit, ducts and manholes are not to be considered all inclusive:

a. Cable shall be installed per manufacture specifications.

b. All cable shall be installed free of kinks. A kink is defined as a violation of the manufacturer's specified Minimum Bend Radius for each type of cable.

c. Cable shall not be formed into a condition that causes the outside sheath to wrinkle.

d. All necessary cable data including maximum pulling tensions, minimum bending radii, shall be obtained by the Telecommunications Contractor from the cable manufacturer before any cable is pulled. Exceeding the recommended pulling tensions or bending radii is not permitted. Any cable placed that exceeds these requirements shall be replaced by the Contractor at no additional cost to the University.

e. The equipment used to pull cable shall have adequate capacity to ensure a steady continuous pull.

f. A suitable flexible feeder tube, cable protectors or sheaves shall be used to protect and guide cable from the cable reel through manholes and into conduit or duct. The radius of the feeder tube shall be as large as possible, but not less than manufacturer's minimum pulling radius.

g. Pulling rope used may be nylon, polypropylene or manila rope. Bare wire winch line may be used upon approval of the CITES Project Managers.

h. Basket weave type grips, wedge type pullers, and swivel harnesses may be used for pulling cables within manufacturer's recommended safe working loads.

i. Only cable pulling lubricants compatible with cable jacket shall be used when pulling cable through conduits.

j. Petroleum base lubricants shall not be used on neoprene jacketed cables. Green oil soap, or soapstone-type lubricants shall not be used because of tendency to cause gumming and packing in the conduit with them. Pulling lubricants in general shall consist of materials with high dielectric strength.

k. Before pulling cable through conduit and duct runs, a mandrel or plug approximately the diameter of the conduit shall be pulled through to check for obstructions. If an obstruction is encountered, a mandrel followed by a swab shall be used to clean out any lint or foreign matter.

l. When cables are installed in their permanent locations, they shall not be bent beyond the radial limitations recommended by the cable manufacturer.

m. All cables and splices shall be supported by a minimum of 2 cable hooks (4 inches or 7 inches). Horizontal racking for support may utilize 3M brand RC-100 rack adapters, manhole racks, or University approved equivalent.

n. Preformed splice cases or University approved equivalent shall be used for splicing throughout the underground system.

o. All splices in manholes shall be encapsulated. Re-enterable polyurethane compound shall be used in accordance to manufacturer's specifications.

p. Spacer webbing shall be permanently adhered to the inside of the case to maintain minimum compound fill.

q. All splice cases in manholes shall be bonded to common grounding bond strap. 3/8 inch copper bond ribbon shall be placed by Contractor if none is in place. Ribbon shall be clamped across manhole ceiling and extended down each wall to 1 foot above floor.

r. Underground feeder cable assignment records for splicing cable will be furnished to the Contractor by CITES upon request.

s. All splicing shall be performed to industry standard practices.

2. Fiber Optics

a. All fiber optic cables shall be installed in MaxCell fabric innerduct. In conduit runs where there is no existing MaxCell, the contractor will install 3, 3", 3 cell innerducts. MaxCell shall be installed per the manufacturer's specifications, including a 3-way chain swivel pulling harness and split termination plugs in buildings and the serving manhole.

b. Cable shall be installed per manufacture specifications.

c. All cable shall be installed free of kinks. A kink is defined as a violation of the manufacturer's specified Minimum Bend Radius for each type of cable.

d. Cable shall not be formed into a condition that causes the outside sheath to wrinkle.

e. All necessary cable data including maximum pulling tensions, minimum bending radii, shall be obtained by the Telecommunications Contractor from the cable manufacturer before any cable is pulled. Exceeding the recommended pulling tensions or bending radii is not permitted. Any cable placed that exceeds these requirements shall be replaced by the Contractor at no additional cost to the University.

f. All fiber optic splicing shall be done by the fusion method.

g. Preformed splice cases shall be used for splicing and encapsulation in manholes throughout the campus system.

h. All fusion splices for multi-mode fiber shall be made with a maximum loss of .35 dB measured at 850 nanometers. All single mode splices shall be a maximum loss of .25 dB measured at 1550 nanometers.

C. Safety/Traffic Regulations

1. All encroachments in city highway rights of way shall be designed, made and maintained in accordance with the following rules:

a. Conformance - *Manual on Uniform Traffic Control Devices*, U.S. Department of Transportation, or applicable statutory requirements of authority having jurisdiction.

b. Operations on or about traffic areas and provisions for regulating traffic will be subject to the regulation of governmental agencies having jurisdiction over the affected areas.

c. Keep traffic areas free of excavated material, installation equipment, pipe, and other materials and equipment.

d. Flagmen - required providing for public safety and the regulation of traffic.

e. Warning signs, lights and audible.

f. Protect all roadways by effective barricades on which are placed warning signs.

g. Provide barricades and warning signs for open trenches, other excavations and obstructions.

h. Illuminate by means of warning lights all barricades and obstructions from sunset to sunrise.

i. Provide an audible warning for all barricades and obstructions at all times for the visually impaired.

D. Acceptance Testing

1. CITES engineers require 24 hours notification prior to any testing being performed, and may, at their option, send representatives to the tests. In addition, the CITES Engineering may make their own tests using similar procedures to confirm the written test results furnished.

2. The Contractor shall perform testing of the entire distribution system installed.

3. Copper - Outside Plant and Riser

a. Testing of all cable pairs from the Node to the IDF terminations.

b. Furnish test equipment and labor to perform test.

c. After the cables are in place and spliced end to end, the system shall be tested for shorts, opens, ground, crosses and transpositions. Correct all splicing/terminating defects, and replace all cables when:

1) Cable pair defects exceed 1 percent of the total number of pairs and/or exceed 2 pairs per 25 pair binder group.

2) Cables requiring splicing due to inadequate length or damage repair.

3) All repair and/or replacement of defective material and labor shall be done at no cost to the University.

4. Fiber Optics

a. The Contractor shall perform the following test procedures, with written reports furnished to the CITES engineers. The CITES engineers shall be notified in advance of all tests, and may, at their option, send representatives to the tests. In addition, the CITES engineers may make their own tests using similar procedures to confirm the written test results furnished.

b. The tools used for optical span line testing are the Optical Time Domain Reflectometer (OTDR) and the Optical Loss Test Set. Acceptance Testing of an optical fiber facility enables the University to:

1) Determine that the cable facility as installed will perform as specified and intended.

2) Verify that the facility meets the purchase specifications.

3) Confirm that the workmanship (i.e. splicing, cable installation, etc.) is acceptable.

4) Provide records that will aid in future maintenance.

c. All Multi-Mode fibers shall be tested for attenuation at 850 and 1300 nanometer wavelengths, all Single-Mode at 1300 and 1550. A record shall be provided of each fiber loss at both wavelengths in both directions. The University will provide blank test forms.

d. Acceptance testing consists of an attenuation measurement and a full OTDR signature. The attenuation measurement shall be performed on an end-to-end, fiber-to-fiber basis using an optical loss test set.

e. The OTDR signature shall also be taken on a fiber-by-fiber basis and used to identify any fiber anomalies. These shall be recorded and evaluated to ensure that no potentially bad fiber or splice is placed in service initially or at a later date. The signature shall be saved (via photograph or other graphic record) for future reference.

f. The following fiber optic tests shall be performed prior to system and customer acceptance:

1) After each splice is made, but before the splice case is closed, its loss shall be measured with an OTDR. Test requirements for a single mode fiber splice is less than or equal to 0.25 dB.

2) After each splice is made, but before the splice case is closed, its loss shall be measured with an OTDR. Test requirements for a multimode fiber splice is less than or equal to 0.3 dB.

3) After the installation of all of the cable is complete and all splices are made and tested, personnel shall perform the cable completion test. This consists of measuring the loss of each fiber path in both directions between fiber optic connectors in the patch panel. The loss measurements shall be made at the operation wavelengths being engineered and planned. Dual window fibers shall be tested at both the long and short wavelengths as specified by the design Specifications.

3.2 INSIDE PLANT CABLE INSTALLATION

A. Raceway Installation

1. Conduit

a. Conduit provided for all communication wiring shall be color coded blue for identification.

b. Conduit shall be metallic and run in the most direct route practical.

c. Conduit runs of 90 feet or more require a pull box.

d. Conduit runs containing more than two 90 degree bends, or a reverse (100 degree) bend require a pull box. See *Drawing 27 00 00-32, Telecommunications Pull Box Schedules*.

e. All offsets shall be rated as equivalent to a 90-degree bend.

f. Conduit bends shall meet a standard of 10 times the outside diameter of conduit unless otherwise approved by the University.

g. Conduits and equipment shall be independently supported. Do not suspend from water, steam or other piping or ducts.

h. Secure all supporting methods by the following means:

1) Toggle bolts in hollow masonry.

2) Expansion bolts in concrete.

3) Wood screws or bolts in wood.

4) Machine screws or bolts in metal surfaces.

i. Conduit support systems shall be securely and adequately installed to preclude movement of conduit and cable tray during cable pulling operations.

j. In multi-level structures, the FDF closets shall be designed so they are stacked one above the other. A minimum of three 4 inch conduits shall connect the closets. These conduits shall have bushings on both ends. Conduits in the closet below shall extend only far enough below the ceiling to permit installation of a bushing or to clear any obstruction that permits access to the conduit. In the closet above, this conduit shall extend a minimum of 3 inches above the finished floor, and a maximum of 5 inches. Conduits shall be placed a maximum of 2 inches away from the finished wall. See *Drawing 27 00 00-33, Telecommunications Sleeves & Conduits Through Floor*.

k. Conduit entering FDF spaces from station outlets shall penetrate the closet walls at a height above the plywood panels and extend only far enough to install bushings.

l. After installation all conduits shall be:

1) Clean, dry, and unobstructed.

2) Covered for protection.

3) Labeled for identification.

m. Allowable fill capacity shall be in accordance with *Drawing 27 00 00-34, Station Cable Conduit Sizing*.

n. Conduit runs for horizontal distribution cables, utilizing the trapeze hanger method to support the conduits, shall utilize threaded rods of not less than 3/8 inch diameter.

o. Flexible conduit, Greenfield type, will not be permitted unless approved by the CITES Construction Coordinator.

p. In areas where station outlets are called for in wire mold, a separate wire mold is required (4000). Sharing wire mold with electricity is not permitted.

q. The systems furniture shall provide a communications wiring raceway separate from electrical cables. Raceway capacities shall be based on a 50 percent fill and allow for 25 percent growth.

r. All raceway elements of the systems furniture and building connections shall be easily accessible so disruption to adjacent work areas is minimized when service is required.

2. Pull Boxes

   a. All pull boxes shall be placed in a straight section of conduit. Do not use boxes in lieu of a bend. If a box is used in lieu of a bend, it shall be replaced at no additional cost to the University.

   b. Align the corresponding conduits at each end with each other.

   c. All pull boxes shall be entirely accessible. Any water, vent, gas or steam pipes limiting access to a pull box shall be re-routed at no additional cost to the University.

   d. All pull boxes shall be complete with covers of same gauge as boxes and secured to boxes with screws.

   e. A hinged access panel shall be provided in the ceiling directly below all pull boxes placed above non-accessible ceilings.

   f. All boxes shall be properly and adequately secured. The conduits entering the box shall not support them.

   g. Secure all supporting methods by the following means:

      1) Toggle bolts in hollow masonry.

      2) Expansion bolts in concrete.

      3) Wood screws or bolts in wood.

      4) Machine screws or bolts in metal surfaces.

   h. All pull boxes shall be sized according to University Standards. See *Drawing 27 00 00-32, Telecommunications Pull Box Schedules.*

3. Cable Trays

   a. Cable trays installed below the ceiling shall conform to *Drawing 27 00 00-35, Telecommunications Typical Below Ceiling Cable Tray.* Station conduit requires a junction box to enter the cable tray.

   b. Cable trays placed above ceilings shall have a 12 inch minimum access above the tray. No other utility may be routed through the cable tray.

   c. The flexible cable tray system shall be only for telecommunications.

   d. Support raceways on approved types of wall brackets or trapeze hangers. Plumbers perforated straps are not permitted as a means of support. Center hung supports will not be allowed. Cable trays shall be installed per the manufacturer's specifications.

   e. When pulling cables through conduits, cable trays and ducts that are supported by threaded rods and unistrut, they shall be braced to withstand the tensions used for pulling cable.

   f. Brackets or hangers shall be manufactured by GS Metals, Unistrut, B-line, or as approved.

g. Secure all supporting methods by the following means:

1) Toggle bolts in hollow masonry.

2) Expansion bolts in concrete.

3) Wood screws or bolts in wood.

4) Machine screws or bolts in metal surfaces.

h. Cable tray support systems shall be securely and adequately installed to preclude movement of conduit and cable tray during cable pulling operations.

4. Communications Outlet Boxes

a. The exact location of outlets and equipment shall be determined by the user and governed by structural conditions and obstructions, or other equipment items. When necessary, relocate outlets so that when fixtures or other devices are installed, they will be symmetrically located according to the room layout and will not interfere with other work or equipment. All station outlets shall be mounted to permit the vertical placement of faceplates.

b. *[Note to AE: Verify final location of all outlets with the Using Agency and the CITES Project Manager prior to finalizing the Contract Documents.]*

c. Standard desk telephone and data outlets shall be fitted with a dual gang plaster ring, and wall mounted telephone outlets shall be fitted with a single gang plaster ring.

d. Outlets shall be serviced individually by a given conduit drop. Looping or "daisy chaining" of outlets is not acceptable.

e. Back-to-back outlets in the same wall, or "thru-wall" type boxes are not permitted. Offset all outlets shown on opposite sides of a common wall to minimize sound transmission.

f. Outlet boxes in finished walls or ceiling shall be fitted with appropriate covers, set to come flush with the finished surface. Sectional switch boxes or utility boxes are permitted where raceways are finished or otherwise concealed. Reasonable effort shall be taken to ensure plaster rings are level.

g. Unless otherwise noted, locate station outlets above finished floor to center line of boxes as follows:

1) Standard telephone and data outlet - 1'-6" or at same height as adjacent duplex outlet.

2) Wall mounted telephone outlet (standard) - 4'-6".

3) Wall mounted outlets and public telephones (which persons who use wheelchairs can only access via a front approach) - 4'-0".

h. Adjust heights of outlets in masonry walls so outlet box will be set in corner of block or brick and align with mortar joints. Outlet height so adjusted shall be consistent in one direction.

i. Where outlets are installed in steel stud type systems, provide additional cross bracing and straps to make the outlet completely rigid prior to application of the wall facing material.

j. Outlets placed above counters shall be installed 8 inches above the back splash. Mounting heights required for these outlets shall be coordinated by the Electrical Contractor per the Contract Documents.

k. Unless otherwise noted, floor outlet boxes with "snap-in" modules designed for voice and data wiring systems shall be designed to accept ORTRONICS module components to provide voice and data services in addition to extending commercial power. Floor boxes shall be a minimum size of 12 1/8" l x 12 1/8" w x 3 1/2" d.

l. When using movable or systems furniture, it is recommended to provide communication services to this area by placing the voice/data jacks in an adjacent stud wall or using recessed floor ports. Placing jacks within the modular furniture is not advised.

m. Systems furniture manufacturers shall provide either two 2-11/16 inch wide by 1-3/8 inch high openings or 1 single gang NEMA opening for every station outlet specified.

n. Communications stations outlets located on both sides of a systems furniture partition shall be offset so they do not interfere with one another.

B. Grounding

1. All conduit and cable tray systems, supports, cabinets, equipment, etc., shall be properly grounded in accordance with the latest edition of the *National Electrical Code (NEC)*, ANSI/TIA/EIA-607, and all other applicable codes and regulations.

2. Provide all bonding wire and jumpers, grounding bushings, clamps, etc., required for complete grounding.

3. Route ground conductors to provide the shortest, most direct path to the ground electrode system.

4. All ground connections shall have clean contact surfaces, tinned and sweated while bolting.

5. Avoid splices in bonding or grounding conductors. If splices are required they shall be cadwelded.

6. Provide a separate grounding conductor, securely grounded on each side of all conduit and cable trays that do not provide a continuous, metallic path. Size in accordance with the *National Electrical Code (NEC).*

7. IDF protector frames shall be grounded by means of a 1/2 inch conduit (minimum) with an insulated #6 AWG (minimum) ground wire to the counterpoise ground system, measured at 5 ohms. The University allows no splices without prior approval.

8. Do not use a gas pipe as the grounding electrode.

9. Any grounding or bonding conductor that is run through a metallic conduit shall be bonded to the conduit on both ends.

C. Cable Installation

1. Copper

a. Cable shall be installed per manufacture specifications.

b. All cables shall be installed in either conduit or cable trays. Free airing of cable is prohibited.

c. The maximum pulling tension for a 4 pair horizontal cable is 25 lbf. Cables damaged by excessive pulling force shall be replaced at no additional cost to the University.

d. The minimum bend radius a 4 pair horizontal cable is 1 inch.

e. Do not walk or step on station cables. Do not run over cable with hand trucks or heavy equipment.

f. All cables, wires and equipment shall be firmly anchored.

g. Ty-rap cable ties shall not be used to support cables. They may be used for securing cables to hooks, etc.

h. Fasteners and supports shall be adequate to support loads with ample safety factors.

i. Plastic wire ties shall not be used to bundle or support Category 6 cables. Velcro wire wraps shall be used to prevent excessive crimping of the cables.

j. All splicing shall be performed to industry standard practices.

k. Splice cases in the IDF for incoming cable shall be mounted to backboards, unless otherwise indicated, using the appropriate hardware and supports.

l. No splice cases shall be permitted in cable trays.

2. Fiber Optics

a. Cable shall be installed per manufacture specifications.

b. All cable shall be installed free of kinks. A kink is defined as a violation of the manufacturer's specified Minimum Bend Radius for each type of cable.

c. Cable shall not be formed into a condition that causes the outside sheath to wrinkle.

d. All necessary cable data including maximum pulling tensions, minimum bending radii, shall be obtained by the Telecommunications Contractor from the cable manufacturer before any cable is pulled. Exceeding the recommended pulling tensions or bending radii is not permitted. Any cable placed that exceeds these requirements shall be replaced by the Contractor at no additional cost to the University.

D. Cable Termination

1. Copper

a. All terminating blocks, cables and terminals shall be marked to conform to the existing numbering system.

b. Identification specifications and examples are detailed on *Drawings 27 00 00-25, 27 00 00-26, 27 00 00-29*, and *27 00 00-36*.

c. A combination of 1 telephone and 1 data jack shall be provided for each telephone outlet, excluding wall mounted telephones and wireless access points.

d. 1 telephone jack shall be installed for each wall mounted telephone location.

e. Only modules with removable insulation displacement connectors (IDC's) for station cable termination are permitted. See *Drawing 27 00 00-37, Telecommunications PIN Configurations For Voice/Data Jacks*. Cable shall be terminated per TIA 568-A wiring standard.

f. When terminating Cat 6 a maximum of ½ inch of sheath can be removed at the jack and patch panel with twist remaining intact.

2. Fiber Optics

a. Fiber optic cables terminated at the jack locations shall be terminated with field installable connectors. Splicing to factory made pigtails will not be allowed. The maximum allowable loss is .5dB per termination.

b. Fiber optic cables with less than 48 fibers terminated at the building CERs shall utilize Ortronics Fiber Interconnect Cabinet model OR-FC02U-C. Mulitmode fiber will be terminated with ST ultra polished connectors (UPC) duplex connectors and adapter panels. Single mode fiber will be terminated with SC ultra polished connectors (UPC) duplex connectors and adapter panels.

1) Single Mode Adapter Panels OR-OFP-SCD12AC

2) Multimode Adapter Panels OR-OFP-STD12MB

c. Fiber optic cables with more than 48 strands of fiber shall be terminated at the building shall utilize Corning Fiber Optic Termination Housing model CCH-04U and Splice Housings model CSH-03U. Mulitmode fiber will be terminated with ST ultra polished connectors (UPC) duplex connectors and adapter panels. Single mode fiber will be terminated with SC ultra polished connectors (UPC) duplex connectors and adapter panels.

1) Single Mode Adapter Panels CCH-CP12-59

2) Multimode Adapter Panels CCH-CP12-15T

E. Cable Identification

1. Copper

a. Station jacks shall carry a 7 digit number (maximum). This designation shall be on the face of the jack plate, on the BIX 1A strip, and the patch panel. Each end of the station wiring cables shall also carry the same designation. The University shall supply labels for the BIX 1A's. The jack numbers shall be assigned by the installing vendor, with approval of the CITES Project Manager prior to installation.

b. All jack faceplates, BIX strips, patch panels, and patch panel ports shall be clearly labeled with the appropriate designation.

c. An example of the voice jack designation is: See *Drawing 27 00 00-36, Telecommunications Typical Station Outlet Identification.*

1A-B-01

1) The first 3 characters (2 in this example) identify the floor and the FDF feeding the jack. In this case, the "A" terminal is on the first floor.

2) The next 2 characters (1 in this example) identify the floor that the jack is actually located on. In this case, the jack is located in the basement.

3) The last 3 characters (2 in this example) are the jack number. This is a consecutive number indicating the number of jacks served by the FDF.

d. An example of the Category 6 data jack designation is: See *Drawing 27 00 00-36, Telecommunications Typical Station Outlet Identification.*

HA-P1-01

1) The first and third letters (H and P) are constant.

2) The second character identifies the Data Hub. In this example, the data cables terminate in Hub A.

3) The fourth character identifies which patch panel in the Data Hub that the cables are terminated on.

4) The last 2 characters are a consecutive number indicating which port on the patch panel the cable is terminated on. This number shall not exceed the number of ports of the patch panel.

2. Fiber Optic Cables

a. Fiber optic riser cables shall be identified as to the type of fiber (single mode, multimode, or laser enhanced multimode) and shall be clearly labeled at end of the cable and the terminating panel with the appropriate designation.

b. An example of labeling shall be SMSSA, 1-12 for single mode cables, LGSSA, 1-12 for multimode cables and LG50SSA, 1-12 for laser enhanced multimode cables.

1) The first 2-4 characters identify the type of fiber.

2) The next 2 characters (SS) remain constant.

3) The next character represents the number or cables in alphanumeric order (A through Z).

4) The numeric numbers represents the number of fibers within the cable.

F. Emergency Telephones

1. Indoor and elevator telephones shall be required for all new buildings as specified by campus security. See *Drawings 27 00 00-11*. All elevator cabs shall be designed to include an emergency phone.

2. Elevator Telephones

    a. Emergency telephones shall be provided in elevators on all major replacement, remodeling and new construction Projects on the U of I Campus, and shall meet the following minimum requirements. *[Note to AE: Include wording in appropriate section of construction documents and show on electrical or telecommunications drawings to ensure coordination of elevator-related requirements.]*

    b. Provide a 2 pair, 24 AWG shielded telephone cable in the elevator traveling cable and make provision in the cab for telephone installation.

    c. Follow American Disabilities Act (ADA) specifications and Illinois Accessibility Standards in determining mounting in elevator cab specifications.

    d. Provide a conduit and voice and data cable to elevator equipment controller. In new buildings, the voice and data cables shall be run to the designated CER. In existing buildings that have separate CERs and FDFs, the data cable shall run back to the closest CER and the voice cable to the closest FDF. The data cable cannot exceed 300 feet. This needs to be coordinated with CITES.

    e. Provide a dedicated telephone line connection in elevator equipment area for extension to traveling cable.

    f. *[Note to AE: Procurement of and Financial Responsibility for Elevator Emergency Phone: With the exception of CDB projects where this is not allowed, all projects shall provide funding to procure, purchase, and install the elevator emergency telephone.]*

G. Acceptance Testing

1. CITES engineers require 24 hours notification prior to any testing being performed, and may, at their option, send representatives to the tests. In addition, the CITES Engineering may make their own tests using similar procedures to confirm the written test results furnished.

2. The vendor shall perform testing of the entire distribution system installed.

    a. Station/Horizontal Cable

        1) Testing of all cable pairs from the jack to the Category 6e patch panel in the CER.

        2) Station wiring shall pass Category 6e certification tests. Limits for impedance, loop, resistance, capacitance, attenuation, and NEXT shall not exceed Category 6e requirements.

        3) Horizontal cables shall be free of shorts within the pairs, and be verified for continuity, pair validity and polarity, and conductor position on the jack. Any defective, split or mis-positioned pairs must be identified and corrected.

4) Category 6e horizontal cable shall also be tested to 250 MHz as defined by TIA/EIA-568-A. Measurements shall be of the “Basic Link” including cabling and modular jacks as the outlet and patch panel. Parameters to be tested must include:

   (i) Wire Map

   (ii) Length

   (iii) NEXT Loss (Pair- to- Pair)

   (iv) NEXT (Power Sum)

   (v) ELFEXT (Pair-to-Pair)

   (vi) ELFEXT (Power Sum)

   (vii) Return Loss

   (viii) Attenuation

   (ix) Propagation Delay

   (x) Delay Skew

5) The maximum length of horizontal cable shall not exceed 295 feet (90m).

6) To establish testing baselines, cable samples of known length and of the cable type and lot installed shall be tested. The cable may be terminated with an eight-position Cat. 6 modular connector to facilitate testing. Net Propagation Velocity (NPV) and nominal attenuation values shall be calculated based on this test and be utilized during the testing of the installed cable plant. This requirement can be waived if NPV data is available from the cable manufacturer for the exact cable under test.

7) Cat.6 horizontal cable testing shall be performed using a test instrument designed for testing to 250 MHz or higher. Test records shall verify, “PASS” on each cable and display the specified parameters, comparing test values with standards based on “templates” integral to the unit. Field testers that report “PASS*”, FAIL*” or Fail result for any of the parameters will not be accepted.

8) In the event results of the test are not satisfactory, the contractor shall make adjustments, replacement and changes as necessary and shell repeat the test that failed.

9) Upon completion of the installation, the contractor shall submit as-builts per the requirements of this Section and *Section 01 78 39 – Project Record Documents*.

10) Test results shall be documented electronically, saved, and a copy printed for CITES.

11) Test results shall include a record of test frequencies, cable type, conductor pair and jack identification, measurement direction, test equipment type, model and serial number, date, reference setup, and crew member names.

END OF SECTION **27** 00 00

This section of the *U of I Facilities Standards* establishes minimum requirements only. It should not be used as a complete specification.