

SPECIFICATIONS TABLE OF CONTENTS

000001	SEALS PAGE
000002	TABLE OF CONTENTS

VOLUME 1 OF 4: DIVISIONS 00 – 01**DIVISION 00 – BIDDING AND CONTRACT REQUIREMENTS**

001030	ECONOMIC INCLUSION
001100	INVITATION TO BID
002113	INSTRUCTIONS TO BIDDERS
002213	SUPPLEMENTARY INSTRUCTIONS TO BIDDERS
003000	AVAILABLE INFORMATION
004200	SUPPLEMENTARY BID FORM
004300	STANDARD FORMS
004313	BID SECURITY
004325	BID PERIOD SUBSTITUTION REQUEST
004339	MWVBE PARTICIPATION LIST
004350	SUBCONTRACTORS AND PRODUCT LIST
004510	BIDDER'S CERTIFICATION OF AUTHORIZED EMPLOYMENT
004519	INDIANA FORM 96
004520	CERTIFICATION NON-INVESTMENT IRAN
004900	RESPONSIBLE BIDDER ORDINANCE
005214	STANDARD FORM OF AGREEMENT
006113	PERFORMANCE BOND AND PAYMENT
006216	INSURANCE CERTIFICATES
007216	GENERAL CONDITIONS
007300	SUPPLEMENTARY CONDITIONS

DIVISION 01 – GENERAL REQUIREMENTS

011000	SUMMARY
011200	MULTIPLE CONTRACT SUMMARY
012300	ALTERNATES
012600	CONTRACT MODIFICATION PROCEDURES
012973	SCHEDULE OF VALUES
012983	APPLICATION FOR PAYMENT
013119	PROJECT MEETINGS
013123	WEB ASED PROJECT MANAGEMENT
013200	SCHEDULES AND REPORTS
013300	SUBMITTAL PROCEDURES
014000	QUALITY REQUIREMENTS
014510	TESTING LABORATORY SERVICES
015000	TEMPORARY FACILITIES AND CONTROLS
015113	TEMPORARY ELECTRICITY
015116	TEMPORARY FIRE PROTECTION
015123	TEMPORARY HVAC

015133	TEMPORARY TELEPHONE
015136	TEMPORARY WATER
015139	TEMPORARY SANITARY FACILITIES
015200	PROJECT OFFICE
015213	OFFICES SHEDS
015260	RUBBISH CONTAINER
015400	CONSTRUCTION AIDS AND TEMPORARY ENCLOSURES
015500	ACCESS ROADS PARKING AREAS
015623	BARRICADES
015626	FENCES
015639	TREE AND PLANT PROTECTION
015713	ENVIRONMENTAL PROTECTION
015726	DUST CONTROL
015729	WATER CONTROL
016000	PRODUCT REQUIREMENTS
017123	FIELD ENGINEERING
017123.13	WORK LAYOUT
017133.13	UTILITY PROTECTION
017329	CUTTING AND PATCHINGC
017413	HOUSEKEEPING SAFETY
017423	FINAL CLEANING
017700	CONTRACT CLOSEOUT

VOLUME 2 OF 4: DIVISIONS 03 – 13

DIVISION 03 – CONCRETE

031000	CONCRETE FORMING AND ACCESSORIES
032000	CONCRETE REINFORCING
033000	CAST-IN-PLACE CONCRETE
034100	PRECAST STRUCTURAL CONCRETE
034130	PRECAST PRESTRESSED HOLLOWCORE SLAB UNITS

DIVISION 04 – MASONRY

042113	BRICK MASONRY
042200	CONCRETE UNIT MASONRY
047200	CAST STONE MASONRY

DIVISION 05 – METALS

050553	SECURITY METAL FASTENINGS
051200	STRUCTURAL STEEL FRAMING
051213	ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING
052100	STEEL JOIST FRAMING
053100	STEEL DECKING
054000	COLD-FORMED METAL FRAMING
055000	METAL FABRICATIONS

055119	METAL GRATING STAIRS
055213	PIPE AND TUBE RAILINGS
055300	METAL GRATINGS

DIVISION 06 – WOOD, PLASTICS AND COMPOSITES

061053	MISCELLANEOUS ROUGH CARPENTRY
061600	SHEATHING

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

071326	SELF-ADHERING SHEET WATERPROOFING
072100	THERMAL INSULATION
072419	WATER DRAINAGE EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)
072500	WEATHER BARRIERS
072600	VAPOR RETARDERS
074243	MODULAR METAL WALL, ROOF AND SOFFIT PANELS
075423	THERMOPLASTIC POLYOLEFIN (TPO) ROOFING
077100	ROOF SPECIALTIES
077200	ROOF ACCESSORIES
077213	MANUFACTURED ACCESS CURBS AND COVERS FOR CONVENTIONAL ROOFS
077253	SNOW GUARDS
078100	APPLIED FIREPROOFING
078123	INTUMESCENT FIREPROOFING
078413	PENETRATION FIRESTOPPING
078443	JOINT FIRESTOPPING
079100	PREFORMED JOINT SEALS
079200	JOINT SEALANTS

DIVISION 08 – OPENINGS

081113	HOLLOW METAL DOORS AND FRAMES
081416	FLUSH WOOD DOORS
083113	ACCESS DOORS AND FRAMES
083119	SECURITY ACCESS DOORS AND FRAMES
083323	OVERHEAD COILING DOORS
083463	DETENTION DOORS AND FRAMES
083613	SECTIONAL DOORS
084113	ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
084413	GLAZED ALUMINUM CURTAIN WALLS
084523	FIBERGLASS SANDWICH-PANEL ASSEMBLIES
085663	DETENTION WINDOWS AND SKYLIGHTS
087100	DOOR HARDWARE
087163	DETENTION DOOR HARDWARE
087163 A	DETENTION DOOR HARDWARE SETS
088000	GLAZING
088853	SECURITY GLAZING
089119	FIXED LOUVERS

DIVISION 09 – FINISHES

092216	NON-STRUCTURAL METAL FRAMING
092900	GYPSUM BOARD
093000	TILING
095113	ACOUSTICAL PANEL CEILINGS
095753	SECURITY CEILING ASSEMBLIES
096513	RESILIENT BASE AND ACCESSORIES
096519	RESILIENT TILE FLOORING
096566	RESILIENT ATHLETIC FLOORING
096623	RESINOUS MATRIX TERRAZZO FLOORING
096723	RESINOUS FLOORING
096725	SEAMLESS SHOWER COATINGS
096813	CARPETING
096900	ACCESS FLOORING
097200	WALL COVERINGS
097863	SAFETY PADDING
098410	FIXED SOUND ABSORBING PANELS
099113	EXTERIOR PAINTING
099123	INTERIOR PAINTING

DIVISION 10 – SPECIALTIES

101100	VISUAL DISPLAY UNITS
101416	PLAQUES
101419	DIMENSIONAL LETTER SIGNAGE
101423	PANEL SIGNAGE
101426	POST AND PANEL – PYLON SIGNAGE
102113	TOILET COMPARTMENTS
102132	WELDING CURTAINS
102600	WALL PROTECTION
102800	TOILET, BATH AND LAUNDRY ACCESSORIES
102813.63	DETENTION TOILET ACCESSORIES
104413	FIRE EXTINGUISHER CABINETS
104416	FIRE EXTINGUISHERS
105113	METAL LOCKERS
105114	EVIDENCE LOCKERS
105626	MOBILE STORAGE SHELVING
105700	RAPID ENTRY LOCKBOX
107316	ALUMINUM CANOPIES
107500	FLAGPOLES

DIVISION 11 – EQUIPMENT

111736	PACKAGE TRANSFER UNITS
111800	SECURITY EQUIPMENT
111900	DETENTION EQUIPMENT CONTRACTOR

111903	SECURITY SCREEN-WOVEN ROD
111916	DETENTION GUN LOCKERS
112923	INMATE PROPERTY PACKAGING EQUIPMENT
114000	FOOD SERVICE EQUIPMENT
115313	LABORATORY FUME HOODS

DIVISION 12 – FURNISHINGS

122113	HORIZONTAL LOUVER BLINDS
123216	MANUFACTURED PLASTIC-LAMINATE-FACED CASEWORK
123553.13	METAL LABORATORY CASEWORK
123616	METAL COUNTERTOPS
123661	SOLID SURFACING COUNTERTOPS
125283	FIXED BEAM SEATING
125500	DETENTION FURNITURE
125600	INSTITUTIONAL FURNITURE
129300	SITE FURNISHINGS

DIVISION 13 – SPECIAL CONSTRUCTION

135500	PREFABRICATED MODULAR STEEL CELLS
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VOLUME 3 OF 4: DIVISIONS 21 – 23**DIVISION 21 – FIRE SUPPRESSION**

210517	SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING
210518	ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING
210523	GENERAL-DUTY VALVES FOR FIRE PROTECTION PIPING
210529	HANGERS AND SUPPORTS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT
210548	VIBRATION & SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING & EQUIPMENT
210553	IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
211119	FIRE DEPARTMENT CONNECTIONS
211313	WET-PIPE SPRINKLER SYSTEMS
211316	DRY-PIPE SPRINKLER SYSTEMS

DIVISION 22 – PLUMBING

220513	COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT
220516	EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
220517	SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING
220518	ESCUTCHEONS FOR PLUMBING PIPING
220519	METERS AND GAGES FOR PLUMBING PIPING
220523.12	BALL VALVES FOR PLUMBING PIPING
220523.13	BUTTERFLY VALVES FOR PLUMBING PIPING
220523.14	CHECK VALVES FOR PLUMBING PIPING
220523.15	GATE VALVES FOR PLUMBING PIPING
220529	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

220548.13	VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
220553	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
220719	PLUMBING PIPING INSULATION
221113	FACILITY WATER DISTRIBUTION PIPING
221116	DOMESTIC WATER PIPING
221119	DOMESTIC WATER PIPING SPECIALTIES
221123.13	DOMESTIC WATER-PACKAGED BOOSTER PUMPS
221123.21	INLINE, DOMESTIC WATER PUMPS
221313	FACILITY SANITARY SEWERS
221316	SANITARY WASTE AND VENT PIPING
221319	SANITARY WASTE PIPING SPECIALTIES
221319.13	SANITARY DRAINS
221323	SANITARY WASTE INTERCEPTORS
221329	SANITARY SEWERAGE PUMPS
221413	FACILITY STORM DRAINAGE PIPING
221423 S	TORM DRAINAGE PIPING SPECIALTIES
221429	SUMP PUMPS
221613	FACILITY NATURAL-GAS PIPING
223100	DOMESTIC WATER SOFTENERS
223400	FUEL-FIRED DOMESTIC WATER HEATERS
224100	RESIDENTIAL PLUMBING FIXTURES
224213.13	COMMERCIAL WATER CLOSETS
224213.16	COMMERCIAL URINALS
224216.13	COMMERCIAL LAVATORIES
224216.16	COMMERCIAL SINKS
224223	COMMERCIAL SHOWERS
224500	EMERGENCY PLUMBING FIXTURES
224600	SECURITY PLUMBING FIXTURES
224716	PRESSURE WATER COOLERS

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING

230513	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230516	EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING
230517	SLEEVES AND SLEEVE SEALS FOR HVAC PIPING
230518	ESCUTCHEONS FOR HVAC PIPING
230519	METERS AND GAGES FOR HVAC PIPING
230523.11	GLOBE VALVES FOR HVAC PIPING
230523.12	BALL VALVES FOR HVAC PIPING
230523.13	BUTTERFLY VALVES FOR HVAC PIPING
230523.14	CHECK VALVES FOR HVAC PIPING
230523.15	GATE VALVES FOR HVAC PIPING
230523.16	PLUG VALVES FOR HVAC PIPING
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
230548.13	VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT
230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC
230713	DUCT INSULATION

230716	HVAC EQUIPMENT INSULATION
230719	HVAC PIPING INSULATION
230923	DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC
230924	REFRIGERANT DETECTION AND ALARM
232113	HYDRONIC PIPING
232116	HYDRONIC PIPING SPECIALTIES
232123	HYDRONIC PUMPS
232300	REFRIGERANT PIPING
232513	WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS
233113	METAL DUCTS
233300	AIR DUCT ACCESSORIES
233346	FLEXIBLE DUCTS
233423	HVAC POWER VENTILATORS
233433.13	COMMERCIAL AIR CURTAINS
233600	AIR TERMINAL UNITS
233713.13	AIR DIFFUSERS
233713.23	REGISTERS, AND GRILLES
233713.43	SECURITY REGISTERS, AND GRILLES
233723	HVAC GRAVITY VENTILATORS
235123	GAS VENTS
235216	CONDENSING BOILERS
235523.13	LOW-INTENSITY, GAS-FIRED, RADIANT HEATERS
236426.13	AIR-COOLED, ROTARY-SCREW WATER CHILLERS
237313.13	INDOOR, BASIC AIR-HANDLING UNITS
237416.11	PACKAGED, SMALL-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS
237433	DEDICATED OUTDOOR-AIR UNITS
238123.13	COMPUTER-ROOM AIR-CONDITIONERS, CEILING-MOUNTED UNITS
238126	SPLIT-SYSTEM AIR CONDITIONERS
238219	FAN COIL UNITS
238239.16	PROPELLER UNIT HEATERS
238239.19	WALL AND CEILING UNIT HEATERS

VOLUME 4 OF 4: DIVISIONS 26 – 33

DIVISION 26 – ELECTRICAL

260519	LOW VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES
260526	GROUNDING & BONDING FOR ELECTRICAL SYSTEMS
260529	HANGARS AND SUPPORTS FOR ELECTRICAL SYSTEMS
260533	RACEWAY & BOXES FOR ELECTRICAL SYSTEMS
260544	SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING
260548.16	SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS
260573.13	SHORT-CIRCUIT STUDIES
260573.16	COORDINATION STUDIES
260573.19	ARC-FLASH HAZARD ANALYSIS
260923	LIGHTING CONTROL DEVICES
262213	LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

262313	PARALLELING LOW-VOLTAGE SWITCHGEAR
262413	SWITCHBOARDS
262416	PANELBOARDS
262500	ENCLOSED BUS ASSEMBLIES
262726	WIRING DEVICES
262813	FUSES
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
262913.03	MANUAL AND MAGNETIC MOTOR CONTROLLERS
262923	VARIABLE FREQUENCY MOTOR CONTROLLERS
263213	DIESEL ENGINE GENERATORS
263214	STATIONARY LOAD BANK WITH AUTOMATIC LOAD LEVELING CONTROL
263353	STATIC UNINTERRUPTIBLE POWER SUPPLY
263600	TRANSFER SWITCHES
264313	SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS
265119	LED INTERIOR LIGHTING
265613	LIGHTING POLES AND STANDARDS
265619	LED EXTERIOR LIGHTING

DIVISION 27 - COMMUNICATIONS

270526	GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
270528	PATHWAYS FOR COMMUNICAITONS SYSTEMS
270529	HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS
270536	CABLE TRAYS FOR COMMUNICATIONS SYSTEMS
270544	SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING
270548.16	SEISMIC CONTROLS FOR COMMUNICATIONS SYSTEMS
270553	IDENTIFICATION FOR COMMUNICATIONS SYSTEMS
271100	COMMUNICATIONS EQUIPMENT ROOM FITTINGS
271116	COMMUNICATIONS RACKS, FRAMES, AND ENCLOSURES
271300	COMMUNICATIONS BACKBONE CABLING
271500	COMMUNICATIONS HORIZONTAL CABLING
274133	MASTER ANTENNA TELEVISION SYSTEM

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

280500	COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY
280510	CABINETS AND ENCLOSURES FOR ELECTRONIC SAFETY AND SECURITY
281300	ACCESS CONTROL SYSTEM
282300	VIDEO COMMUNICATION SYSTEM
284619	SECURITY AUTOMATION SYSTEM
284620	VIDEO GRAPHIC USER INTERFACE
284621.11	ADDRESSABLE FIRE-ALARM SYSTEMS
285123	IP AUDIO COMMUNICATION SYSTEM

DIVISION 31 – EARTHWORK

311000	SITE CLEARING
312000	EARTH MOVING

- 312319 DEWATERING
- 315000 EXCAVATION SUPPORT AND PROTECTION

316400 ENGINEERED AGGREGATE PIERS

DIVISION 32 – EXTERIOR IMPROVEMENTS

- 321216 ASPHALT PAVING
- 321313 CONCRETE PAVING
- 321373 CONCRETE PAVING JOINT SEALANTS
- 321400 UNIT PAVING
- 321713 PARKING BUMPERS
- 321723 PAVEMENT MARKINGS
- 321726 TACTILE WARNING SURFACING
- 323113.53 HIGH-SECURITY CHAIN LINK FENCES AND GATES
- 323119.53 DECORATIVE METAL SECURITY FENCES AND GATES
- 329113 SOIL PREPARATION
- 329200 TURF AND GRASSES
- 329300 PLANTS

DIVISION 33 – UTILITIES

- 334100 STORM UTILITY DRAINAGE PIPING
- 334600 SUBDRAINAGE

END OF SECTION 000002

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SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. UTP cabling.
2. 50/125-micrometer, optical fiber cabling.
3. Coaxial cable.
4. Multiuser telecommunications outlet assemblies.
5. Cable connecting hardware, patch panels, and cross-connects.
6. Telecommunications outlet/connectors.
7. Cabling system identification products.
8. Cable management system.

B. Related Requirements:

1. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.
- F. LAN: Local area network.

- G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- I. RCDD: Registered Communications Distribution Designer.
- J. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For coaxial cable, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- B. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in Microsoft Excel software.
 - 2. Cabling administration drawings and printouts.
 - 3. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 - 4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Patch-Panel Units: One of each type.
2. Connecting Blocks: One of each type.
3. Device Plates: One of each type.
4. Multiuser Telecommunications Outlet Assemblies: One of each type.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 3. Bridged taps and splices shall not be installed in the horizontal cabling.
 4. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately 100 sq. ft., and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 50 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Grounding: Comply with J-STD-607-A.

2.3 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.

2.4 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Premise Wiring.
 2. 3M.
 3. AMP NETCONNECT; a TE Connectivity Ltd. company.
 4. Belden CDT Networking Division/NORDX.
 5. Berk-Tek Leviton; a Nexans/Leviton alliance.
 6. CommScope, Inc.
 7. Draka USA.
 8. General Cable; General Cable Corporation.
 9. Genesis Cable Products; Honeywell International, Inc.
 10. Mohawk; a division of Belden Networking, Inc.
 11. Superior Essex Inc.
 12. SYSTIMAX Solutions; a CommScope Inc. brand.
- B. Description: 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 3. Comply with TIA/EIA-568-B.2, Category 6.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG.
 - b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 - c. Communications, Riser Rated: Type CMR, complying with UL 1666.
 - d. Communications, Limited Purpose: Type CMX.
 - e. Multipurpose: Type MP or MPG.
 - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
 - g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.5 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Leviton Manufacturing Co., Inc.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

- C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- E. Patch Cords: Factory-made, four-pair cables in 48-inch lengths; terminated with eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

2.6 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. 3M.
 - 2. AMP NETCONNECT; a TE Connectivity Ltd. company.
 - 3. Belden CDT Networking Division/NORDX.
 - 4. Berk-Tek Leviton; a Nexans/Leviton alliance.
 - 5. CommScope, Inc.
 - 6. Corning Cable Systems.
 - 7. CSI Technologies Inc.
 - 8. General Cable; General Cable Corporation.
 - 9. Mohawk; a division of Belden Networking, Inc.
 - 10. Superior Essex Inc.
 - 11. SYSTIMAX Solutions; a CommScope Inc. brand.
- B. Description: Multimode, 50/125-micrometer, 24-fiber, nonconductive, tight buffer, optical fiber cable.
 - 1. Comply with ICEA S-83-596 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.3 for performance specifications.
 - 3. Comply with TIA-492AAAB for detailed specifications.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. General Purpose, Nonconductive: Type OFN or OFNG.
 - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
 - d. General Purpose, Conductive: Type OFC or OFCG.
 - e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
 - f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.

5. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
6. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket:

1. Jacket Color: Aqua for 50/125-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.7 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Leviton Manufacturing Co., Inc.

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.

D. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
2. Quick-connect, simplex and duplex, Type SC or Type LC connectors. Insertion loss not more than 0.75 dB.
3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.8 COAXIAL CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire.
2. Belden CDT Networking Division/NORDX.
3. Coleman Cable, Inc.
4. CommScope, Inc.
5. Draka USA.

- B. Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- C. RG-11/U: NFPA 70, Type CATV.
 - 1. No. 14 AWG, solid, copper-covered steel conductor.
 - 2. Gas-injected, foam-PE insulation.
 - 3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
 - 4. Jacketed with sunlight-resistant, black PVC or PE.
 - 5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.
- D. RG59/U: NFPA 70, Type CATVR.
 - 1. No. 20 AWG, solid, silver-plated, copper-covered steel conductor.
 - 2. Gas-injected, foam-PE insulation.
 - 3. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip.
 - 4. Color-coded PVC jacket.
- E. RG-6/U: NFPA 70, Type CATV or CM.
 - 1. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
 - 2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
 - 3. Jacketed with black PVC or PE.
 - 4. Suitable for indoor installations.
- F. RG59/U: NFPA 70, Type CATV.
 - 1. No. 20 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
 - 2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.
 - 3. PVC jacket.
- G. RG59/U (Plenum Rated): NFPA 70, Type CMP.
 - 1. No. 20 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
 - 2. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.
 - 3. Copolymer jacket.
- H. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
 - 1. CATV Cable: Type CATV.

2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
3. CATV Riser Rated: Type CATVR, complying with UL 1666.
4. CATV Limited Rating: Type CATVX.

2.9 MULTIUSER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Belden CDT Networking Division/NORDX.
 2. Chatsworth Products, Inc.
 3. Hubbell Premise Wiring.
 4. Molex Premise Networks.
 5. Ortronics, Inc.
 6. Panduit Corp.
 7. Siemon Co. (The).
- B. Description: MUTOAs shall meet the requirements for cable connecting hardware.
1. Number of Terminals per Field: One for each conductor in assigned cables.
 2. Number of Connectors per Field:
 - a. One for each four-pair UTP cable indicated.
 - b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.
 3. Mounting: Wall.
 4. NRTL listed as complying with UL 50 and UL 1863.
 5. Label shall include maximum length of work area cords, based on TIA/EIA-568-B.1.
 6. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.10 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: Four-port-connector assemblies mounted in single faceplate.
1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
 2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.

3. Legend: Machine printed, in the field, using adhesive-tape label.

2.11 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with J-STD-607-A.

2.12 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

2.13 SOURCE QUALITY CONTROL

- A. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- B. Factory test UTP cables according to TIA/EIA-568-B.2.
- C. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.
- D. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where

unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements in Section 270528 "Pathways for Communications Systems."
3. Comply with requirements in Section 270536 "Cable Trays for Communications Systems."

B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. MUTOA shall not be used as a cross-connect point.
5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 12. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
 13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.
 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-B.3.
 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
 2. Install cabling after the flooring system has been installed in raised floor areas.
 3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.
- G. Outdoor Coaxial Cable Installation:
1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
 2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.
- H. Group connecting hardware for cables into separate logical fields.
- I. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.

- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Administration Class: 2.
 - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration, including optional identification requirements of this standard.
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- G. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
 6. UTP Performance Tests:
 - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
 - 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.
 7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.
 8. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
 - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
 - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- B. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration spreadsheet software.

END OF SECTION 271500

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SECTION 274133 - MASTER ANTENNA TELEVISION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. MATV equipment using cable television service as the signal source.
- 2. MATV head-end components.
- 3. Distribution components.

B. Related Sections:

- 1. Section 271300 "Communications Backbone Cabling" for coaxial, UTP, and fiber-optic cables and connectors.
- 2. Section 271500 "Communications Horizontal Cabling" for coaxial, UTP, and fiber-optic cables and connectors.

1.3 DEFINITIONS

- A. Agile Receiver: A broadband receiver that can be tuned to any desired channel.
- B. A/V: Audio/Visual.
- C. Broadband: For the purposes of this Section, wide bandwidth equipment or systems that can carry signals occupying in the frequency range of 54 to 1002 MHz. A broadband communication system can simultaneously accommodate television, voice, data, and many other services.
- D. Carrier: A pure-frequency signal that is modulated to carry information. In the process of modulation, the signal is spread out over a wider band. The carrier frequency is the center frequency on any television channel.
- E. CATV: Community antenna television. A communication system that simultaneously distributes several different channels of broadcast programs and other information to customers via a coaxial cable.
- F. CCTV: Closed-circuit television.

- G. CEA: Consumer Electronics Association.
- H. dBmV: Decibels relative to 1 mV across 75 ohms. Zero dBmV is defined as 1 mV across 75 ohms. $\text{dBmV} = 20 \log_{10}(V_1/V_2)$ where V_1 is the measurement of voltage at a point having identical impedance to V_2 (0.001 V across 75 ohms).
- I. Headend: The control center of the MATV system, where incoming signals are amplified, converted, processed, and combined into a common cable along with any locally originated television signals, for transmission to user-interface points. It is also called the "central retransmission facility."
- J. I/O: Input/Output.
- K. MATV: Master antenna television. A small television antenna distribution system usually restricted to one or two buildings.
- L. RF: Radio frequency.
- M. User Interface: End point of Contractor's responsibility for Work of this Section. User interfaces are the 75-ohm terminals on device plates.

1.4 SYSTEM DESCRIPTION

- A. System shall consist of cable television service and a coaxial cable distribution system.
 - 1. Distribution of cable television service signals, which includes coordinating with Owner's selected service provider for installation of cable to the service point ready for connection into the distribution system. Obtain signal levels and noise and distortion characteristics from service provider as the point of departure for system layout and final equipment selection.
 - 2. Cable distribution system consisting of coaxial cables, user interfaces, signal taps and splitters, RF amplifiers, signal equalizers, power supplies, and required hardware, complying with CEA-310-E and CEA-2032 and resulting in performance parameters specified in this Section. System shall be capable of distributing television channels according to CEA-542-B.
- B. Hardware Requirements: Use plug-in, modular, solid-state electronic components. Mount amplifiers and other powered equipment in standard 19-inch cabinet complying with CEA-310-E.

1.5 PERFORMANCE REQUIREMENTS

- A. Minimum acceptable performance of distribution system at all user-interface points shall be as follows:
 - 1. RF Video-Carrier Level: Between 3 and 12 dBmV.
 - 2. Relative Video-Carrier Level: Within 3 dB to adjacent channel.

3. Carrier Level Stability, Short Term: Level shall not change more than 0.5 dB during a 60-minute period.
4. Carrier Level Stability, Long Term: Level shall not change more than 2 dB during a 24-hour period.
5. Channel Frequency Response: Across any 6-MHz channel in the 54- to 220-MHz frequency range, referenced to video; signal amplitude shall be plus or minus 1 dB, maximum.
6. Carrier-to-Noise Ratio: 45 dB or more.
7. RF Visual Signal-to-Noise Ratio: 43 dB or more.
8. Antenna Combiner Insertion Loss: 40 dB maximum.
9. Signal Power Splitter and Isolation Tap Return Loss: 17 dB maximum.
10. Cable Connectors Attenuation: Less than 0.1 dB.
11. Cross Modulation: Less than minus 50 dB.
12. Carrier-to-Echo Ratio: More than 40 dB.
13. Composite Triple Beat: Less than minus 53 dB.
14. Second Order Beat: Less than minus 60 dB.
15. Terminal Isolation from Television to Television: 25 dB, minimum.
16. Terminal Isolation between Television and FM: 35 dB, minimum.
17. Hum Modulation: 2 percent, maximum.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For headend and distribution system. Include plans, elevations, sections, details, and attachments to other work.
 1. Show fabrication and installation details for television equipment.
 2. Wiring Diagrams: For power, signal, and control wiring. For UTP or fiber-optic cable, include cross connects, patch panels, and patch cords.

1.7 INFORMATIONAL SUBMITTALS

- A. Equipment List: Include each piece of equipment and include model number, manufacturer, serial number, location, and date of original installation. Insert testing record of each piece of adjustable equipment, listing name of person testing, date of test, and description of as-left set points.
- B. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For headend and distribution system to include in emergency, operation, and maintenance manuals.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Provide no fewer than one of each item listed below. Deliver extra materials to Owner.
 - 1. Fuses: One for every 10 of each type and rating.
 - 2. Splitters: One for every 10 installed.
 - 3. MATV Distribution Power Amplifiers: One for every 10 of each type installed.
 - 4. MATV Signal Traps: One for every 10 of each type used.
 - 5. MATV Attenuators: One for every 10 of each type used.
 - 6. Cable: 100 feet of each type used.

1.10 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: System components shall be equipped and rated for the environments in which they are installed.

1.12 COORDINATION

- A. Coordinate size and location of raceway system and provisions for electrical power to equipment specified in this Section.
- B. Coordinate Work of this Section with requirements of cable television service service provider.
- C. Coordinate sizes and locations of concrete bases with actual equipment provided.
- D. Coordinate installation of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 SYSTEMS REQUIREMENTS

- A. Components: Plug-in, modular, heavy-duty, industrial- or commercial-grade units.
- B. Equipment: Silicon-based, solid-state, integrated circuit devices.
- C. Power Supply Characteristics: Devices shall be within specified parameters for ac supply voltages within the range of 105 to 130 V.

- D. Protect signal cables and connected components against transient-voltage surges by suppressors and absorbers designed specifically for that purpose. Comply with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."
- E. Provide ac-powered equipment with integral surge suppressors complying with UL 1449.
- F. RF and Video Impedance Matching: Signal-handling components, including connecting cable, shall have end-to-end impedance-matched signal paths. Match and balance devices used at connections where it is impossible to avoid impedance mismatch or mismatch of balanced circuits to unbalanced circuits.

2.2 MATV EQUIPMENT

- A. Description: Signal-source components, signal-processing and amplifying equipment, distribution components, and interconnecting wiring. System shall receive, amplify, process, and distribute signals to outlets for receiving sets. Equipment shall translate UHF channels to VHF channels before distribution to outlets.
- B. MATV System Qualitative and Quantitative Performance Requirements: Reception quality of color-television program transmissions at each system outlet from each service and source shall be equal to or superior than that obtained with performance checks specified in "Field Quality Control" Article, using standard, commercial, cable-ready, multiple A/V input color-television receivers.

2.3 MATV HEADEND COMPONENTS

- A. Headend Equipment: Broadband amplifier and/or Single-channel amplifiers for receiving off-air television and FM signals and outputting the signals to cable distribution system. Equip coaxial down-leads of the off-air antennas with preamplifiers to send signals at strength required by headend. Headend component performance specified in this article is minimum acceptable; better performance may be required to comply with minimum acceptable system performance standard in "Performance Requirements" Article.
 - 1. House units in standard 19-inch electronic equipment cabinet complying with EIA 310.
- B. Broadband Amplifier:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ATX Networks Inc.
 - b. Blonder Tongue Laboratories, Inc.
 - c. Channel Master.
 - d. Cisco Systems, Inc.
 - e. Leviton Manufacturing Co., Inc.
 - 2. Frequency Range: 54 to 220 MHz.

3. Frequency Response: Plus or minus 1.0 dB across passband.
4. Maximum Noise: 10 dB.
5. Minimum Return Loss: 16 dB.
6. I/O Impedance: 75 ohms.

C. Single-Channel Amplifiers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ATX Networks Inc.
 - b. Blonder Tongue Laboratories, Inc.
 - c. Channel Master.
 - d. Cisco Systems, Inc.
 - e. Leviton Manufacturing Co., Inc.
2. Frequency: 6 MHz for specified channel.
3. Frequency Response: Plus or minus 0.5 dB.
4. Maximum Noise: 10 dB.
5. Minimum Return Loss: 14 dB.
6. Automatic Gain Control: Plus or minus 1-dB output variation for rated input level range variation.
7. Skirt Rejection: Minus 26 dB at plus or minus 5 MHz from channel center.
8. Sound Trap: Adjustable to 10 VdB of attenuation of the sound carrier.
9. I/O Impedance: 75 ohms.

2.4 DISTRIBUTION COMPONENTS

A. Signal Power Splitters and Isolation Taps: Metal-enclosed directional couplers with brass connector parts. Where installed in signal circuits used to supply cable-powered amplifiers, power throughput capacity shall exceed load by at least 25 percent.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ATX Networks Inc.
 - b. Cisco Systems, Inc.
 - c. Leviton Manufacturing Co., Inc.
2. Return Loss: 17 dB.
3. RFI Shielding: 100 dB.
4. Isolation: 25 dB.
5. I/O Impedance: 75 ohms.

B. Distribution System Amplifiers: Powered by coaxial cable system and equipped with surge protection device and external test points to allow convenient signal monitoring.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ARRIS.
 - b. ATX Networks Inc.
 - c. Cisco Systems, Inc.
 - d. Leviton Manufacturing Co., Inc.
- C. Cable System Power Supplies: Plug-in, modular construction, with surge, short-circuit, and overload protection.
- D. Signal Traps: Packaged filters tuned to interference frequencies encountered in Project.
- E. Attenuators: Passive, of fixed value, and used to balance signal levels.
- F. Terminating Resistors: Enclosed units rated 0.5 W and matched for coaxial impedance.
- G. User-Interface Device: Flush, female-type outlets, designed to mimic power duplex outlet; for mounting in standard outlet box; with metallic parts of anodized brass, beryllium copper, or phosphor bronze. Cable connector mounting shall be semirecessed so its protrusion is flush with the plane of device plate.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ARRIS.
 - b. ATX Networks Inc.
 - c. Canare Corporation of America.
 - d. Cisco Systems, Inc.
 - e. Cisco Systems, Inc.
 - f. Leviton Manufacturing Co., Inc.
 2. Cable Connector: Female, Type F.
 3. Wall Plates: Match materials and finish of power outlets in same space.
 4. Attenuation: Less than 0.1 dB.
 5. Voltage Standing-Wave Ratio: Less than 1.15 to 1.

2.5 ENCLOSURES

- A. Enclosures for Interior, Controlled Environments: NEMA 250, Type 1.
- B. Enclosures for Interior, Uncontrolled Environments: NEMA 250, Type 4.
- C. Enclosures for Exterior Environments: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for antenna to verify actual locations of cable connections before antenna installation.
- B. Examine walls, floors, roofs, equipment bases, and roof supports for suitable conditions where television equipment is to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
- C. Tests and Inspections:
 - 1. Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements.
 - 2. Replace malfunctioning or damaged items.
 - 3. Retest until satisfactory performance and conditions are achieved.
 - 4. Prepare television equipment for acceptance and operational testing.
 - 5. Use an agile receiver and signal strength meter or spectrum analyzer for testing.
 - 6. Test Schedule: Schedule tests after pretesting has successfully been completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
 - 7. Operational Tests: Perform tests of operational system to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
 - 8. Distribution System Acceptance Tests:
 - a. Field-Strength Instrument: Rated for minus 40-dBmV measuring sensitivity and a frequency range of 54 to 812 MHz, minimum. Provide documentation of recent calibration against recognized standards.
 - b. Signal Level and Picture Quality: Use a field-strength meter or spectrum analyzer, and a standard television receiver to measure signal levels and check picture quality at all user-interface outlets.

- 1) Test the signal strength in dBmV at 55, 151, 547, and 750 MHz.
 - 2) Minimum acceptable signal level is 0 dBmV (1000 mV).
 - 3) Maximum acceptable signal level over the entire bandwidth is 15 dBmV.
 - 4) Television receiver shall show no evidence of cross-channel intermodulation, ghost images, or beat interference.
9. Signal-to-Noise-Ratio Test: Use a field-strength meter to make a sequence of measurements at the output of the last distribution amplifier or of another agreed-on location in system. With system operating at normal levels, tune meter to the picture carrier frequency of each of the designated channels in turn and record the level. With signal removed and input to corresponding headend amplifier terminated at 75 ohms, measure the level of noise at same tuning settings. With meter correction factor added to last readings, differences from first set must not be less than 45 dB.
10. Qualitative and Quantitative Performance Tests: Demonstrate reception quality of color-television program transmissions at each user interface from each designated channel and source. Quality shall be equal to or superior than that obtained with performance checks specified below, using a standard, commercial, cable-ready, color-television receiver. Level and quality of signal at each outlet and from each service and source shall comply with the following Specifications when tested according to 47 CFR 76:
- a. RF video-carrier level.
 - b. Relative video-carrier level.
 - c. Carrier level stability, during 60-minute and 24-hour periods.
 - d. Broadband frequency response.
 - e. Channel frequency response.
 - f. Carrier-to-noise ratio.
 - g. RF visual signal-to-noise ratio.
 - h. Antenna combiner insertion loss.
 - i. Signal power splitter loss.
 - j. Cable connector attenuation.
- D. Headend and distribution system will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Cap all unused connectors and seal weathertight.
- 3.4 DEMONSTRATION
- A. Train Owner's maintenance personnel to adjust, operate, and maintain MATV equipment.
1. Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining equipment.

END OF SECTION 274133

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SECTION 280500 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section includes general requirements for Division 28 work and is supplemental and in addition to the requirements of Division 1.
- B. It is the intention of this Division of the Specifications to describe and provide for the furnishing, installing, testing and placing in satisfactory and fully operational condition all equipment, materials and devices necessary to provide a complete Division 28 system.
- C. The Division 28 Security Systems shall be bid to the Detention Equipment Contractor as a complete package. Delineation of responsibilities between the Division 11, 26 and 28 contractors are specified herein.
- D. The Division 28 Security Systems Integrator (SSI) shall be responsible for the coordination, furnishing and installation of all Division 28 systems, which shall include the following:
 - 1. 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY & SECURITY
 - 2. 280510 – CABINETS AND ENCLOSURES
 - 3. 281300 – ACCESS CONTROL SYSTEM
 - 4. 282300 – IP VIDEO COMMUNICATION SYSTEM
 - 5. 284619 – SECURITY AUTOMATION SYSTEM
 - 6. 284620 – VIDEO GRAPHIC USER INTERFACE
 - 7. 285123 – IP AUDIO COMMUNICATION SYSTEM
- E. The Division 26 contractor shall design, furnish, install and place in satisfactory condition all conduits/raceways, boxes (back boxes and junction boxes), conductors and connections and all other materials required for the Division 28 systems specified in the contract documents to be complete and fully operational upon completion of the project.
- F. All cabling provided by the Division 26 contractor shall be in conduit where determined, and continuous between the field device and the head-end equipment location. The Division 26 contractor shall maintain uniform phasing and color-coding throughout system, adhering to the approved Division 28 shop drawings.

- G. The SSI shall coordinate with the Division 26 contractor all requirements of the security electronics cable system including PLC/GUI, video surveillance, access control, audio communications, and other miscellaneous systems per NEC, as shown in the project documents.
- H. The Division 26 contractor shall set in place all SSI-supplied security equipment cabinets, racks and enclosures. The SSI shall provide documentation detailing the required installation.
- I. The Division 26 contractor shall be responsible for the provision and installation/terminations of all required 120VAC power, including UPS circuits, for the security electronics head-end equipment and control station location equipment.
- J. The Division 26 contractor shall be responsible for the installation and terminations of all distribution circuits between Division 26-supplied breaker panels and SSI-supplied utility relay interface panels controlling lighting and power circuits.
- K. The Division 26 contractor shall be responsible for all cabling/conduit coordination in regard to electric locks, position switches, door hardware and door frames supplied by Division 8 and/or Division 11 contractor(s).
- L. The Division 26 contractor shall be responsible for all Division 28 **field device** installation and terminations. The SSI shall be responsible for all **head-end** equipment terminations. The SSI shall be responsible for the installation and terminations of all control station equipment, including GUI PCs, monitors, network client PCs and monitors.
- M. The General Contractor shall provide coordination to ensure that control rooms and rooms housing security electronics head end equipment are completed, clean and have conditioned air as early as possible to facilitate completion of control wiring and terminations. Space shall be free of air-borne particles prior to installation of any Security Electronics Equipment. The Architect shall inspect and approve the condition of these rooms prior to the installation of any active equipment.
- N. The Division 11 contractor shall furnish and install all security hardware, adjust all door position and lock position switches as necessary to properly indicate to the security electronics system, provide all hardware and frame schedules as necessary to pertinent contractors, and provide all wiring diagrams to the SSI and Division 26 contractors for electric locking devices being interfaced to by the security electronics system.
- O. The Owner shall be responsible for providing a high-speed internet connection to the Security Management System for remote diagnostics by the SSI. The Owner shall provide a network connection between their LAN and the video management system. Configuration of the Owner's network switches shall be by the Owner. Inmate Telephone system terminations at the SSI-supplied telephone relay interface panel shall be by the Owner's telephone system contractor.

1.3 DEFINITIONS

- A. UL: Underwriters Laboratories
- B. NEMA: National Electrical Manufacturer's Association

- C. NEC: National Electrical Code
- D. NFPA: National Fire Protection Association
- E. SSI: Security System Integrator

1.4 SUBMITTALS

- A. General: Submit the following information to be included in the submittal package.
- B. Product Data:
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
 - 2. Indicate specification section and paragraph for each item.
 - 3. Indicate listing by UL or other approved testing agency.
 - 4. Data sheets showing multiple products or models shall clearly identify the specific product or model being proposed.
 - 5. Submit in a three-ring binder with hardboard covers.
- C. Shop Drawings: Submitted shop drawings shall be generated utilizing AutoCAD and shall be drawn to the drawing/detail scale. The Electronic Safety and Security shop drawings shall include, but not be limited to the following:
 - 1. Dimensions, weights, loads, required clearances, method of field assembly, location and size of each field connection.
 - 2. Detailed equipment enclosure drawings showing arrangement of all proposed equipment with required wire-way and receptacles shown.
 - 3. System risers showing all required interconnections for the following subsystems along with any special terminations that may be required for that subsystem:
 - a. Overall Electronic Safety and Security System
 - b. PLC I/O Network
 - c. Ethernet Network
 - d. Video Surveillance System
 - e. Digital Intercom System
 - f. Utility & Misc. Systems
 - 4. Submit power system drawings indicating all fuse ID numbers as well as voltage and size.
 - 5. Submit power loading spreadsheets detailing all AC power circuits and DC power supply circuits. The spreadsheet shall indicate each device's steady state and in rush current requirements.
 - 6. Submit device schedules that reference the shop drawings detailing exact termination locations for each security device in the system. The device schedules shall indicate the name, location, termination point, voltage, and fuse ID for each. The schedules shall be categorized by device type (i.e. doors, intercoms, cameras, proximity readers, etc.).
- D. Operation and Maintenance Data: Provide O&M manuals as required below:

- E. The O&M manuals shall include the information required to operate and maintain all Division 28 electronic security system equipment. The information provided shall include the following:
 - 1. Operations manual for GUI and Security Management System.
 - 2. As-built shop drawings, including up-to-date device schedules.
 - 3. Wiring diagrams.
 - 4. CD with manufacturer's installation and operations manuals.
 - 5. Complete list of spare parts being provided.
 - 6. The current contact (including service) information for the SSI.
 - 7. Provide two (2) copies of each operating and maintenance manual. Manuals shall be bound in "D-ring" binders with a detailed table of contents.
 - 8. Provide one electronic copy of the O&M manual for inclusion with the O&M manual deliverables on a USB flash drive.

- F. Software Deliverables: Provide a software binder that shall incorporate the following files and information;
 - 1. Provide a text file containing all operator and administrator-level passwords for the GUI system, Security Management system, digital intercom system, PLC system and DVMS.
 - 2. PC recovery files, GUI runtime licenses, digital intercom system software, VMS software, PLC software, and monitor drivers.

1.5 QUALITY ASSURANCE

- A. Security Systems Integrators
 - 1. Only PRE-QUALIFIED Security System Integrators (SSIs) shall be permitted to bid on the Division 28 Electronic Security Systems.
 - 2. The pre-qualified SSIs shall only be allowed to furnish materials from the manufacturers as specified in the Division 28 specifications.
 - 3. The SSI shall assume sole-source responsibility for the entire electronic security system and shall not subcontract out any programming work associated with the GUI or PLC systems. The SSI shall ensure that all integrated systems are compatible with each other for a complete, fully operational and fully tested system upon completion of the project.
 - 4. The SSI shall furnish and install only new material, unused without any defects.
 - 5. The following pre-qualified Security System Integrators (SSI's) shall be allowed to submit pricing:
 - a. Security Automation Systems, Inc. (Indianapolis, IN)
 - b. Accurate Controls, Inc. (Ripon, WI)
 - c. STANLEY Convergent Security Solutions, Inc. (Fishers, IN)

- B. All work shall conform to the applicable code provisions of the NEC and NFPA (as adopted and amended by the Local Jurisdiction).

1.6 COORDINATION

- A. Coordinate the work of this section to meet the substantial completion date.
- B. Coordinate the delivery and location of items with the Construction Manager.
- C. Special attention is called to the following items. Coordinate all conflicts prior to installation:
 - 1. Location of millwork, control consoles, counters, desks, doors and frames so that Division 28 material is in proper relation to these items.
 - 2. Scheduling of new equipment for installation.
- D. The SSI shall coordinate their security equipment rack space requirements with the Owner in shared spaces.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. SSI shall mark or tag each relevant item of equipment (cameras, housings, monitors, etc.) for the project. The SSI shall deliver equipment at the proper time and location for installation. Equipment received, but not installed shall be placed in secured storage. Handling shall be controlled to prevent losses and delays. Upon delivery, the SSI shall inspect equipment for damage. All damaged items shall be removed from the site and replaced.
- B. For equipment stored off-site, the SSI shall protect equipment from theft or damage. All items stored for the project shall be clearly labeled as such and shall be available for inspection. Shipping receipts for stored items shall be made available upon request. The SSI shall provide appropriate insurance coverage for stored equipment that shall cover all items against theft or damage.

1.8 WARRANTY

- A. The SSI shall warrant all material and workmanship for Division 28 systems for a period of twelve (12) months after substantial completion (see ADJUSTING, section 3.5). The warranty shall cover all material and software provided. The SSI shall provide qualified and/or manufacturer-certified technicians capable of diagnosing and repairing the installed system.
- B. The SSI shall repair or replace (at no cost to the Owner) any defective materials or work when given written notice during the warranty period. Warranty service shall be provided to the Owner during normal working hours. When requested by the Owner, after-hours service (including on-site service) shall be provided and the SSI's applicable labor and travel rates shall apply.
- C. The SSI shall provide emergency service during the 12-month warranty period. The SSI shall provide the owner a 4-hour phone response time and a one business-day response time for major system failures. Major system failures shall be considered those failures which result in limited or no functionality of major electronic security system components, such as a PLC failure or a GUI failure.

- D. The warranty shall exclude acts of vandalism, abuse, neglect, Owner misuse, failure of the Owner to provide continuous environmental conditions for which the installed equipment is rated for, and all other acts beyond the control of the SSI (i.e. – weather damage, floods, fire, lightning, and similar acts).

1.9 EXTRA MATERIALS

- A. The SSI shall reference each specific section in Division 28 for extra materials required. Extra materials shall match products installed and shall be packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspect the conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Verify the accuracy of all dimensions, allowances, and clearances on site prior to commencing with any work that may be affected by those dimensions, allowances, and clearances.
- C. Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in the Contract Documents.
- D. Precautions shall be taken to guard against electrostatic and electromagnetic susceptibility and interference.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Provide complete electronic security system as specified herein.
- B. All system equipment to be contained within equipment racks or cabinets. If more or larger equipment racks or cabinets are required than exist or are indicated on the drawings, allow for such additional equipment racks and cabinets in contract price.
- C. All system equipment and field devices to be held securely in place. Fastenings and supports shall be selected to provide a safety factor of three.
- D. All system equipment equipped with plug in power connectors to be connected to a dedicated receptacle. Do not use tap connectors for plugging in multiple plugs into a single receptacle.

- E. All cable within equipment racks, cabinets, or on backboards, to be neatly bundled and secured.
- F. Wires shall not be nicked, have strands removed, or have frayed strands when removing insulation or terminating.
- G. Factory manufactured interface cables to be provided for each field interface board. Terminal blocks to be provided in cabinet or on backboard for factory cable interface to field wiring.
- H. Provide adequate ventilation for all heat radiating equipment. SSI shall provide fan kits as required to maintain rated operating temperature of installed equipment.
- I. Seal-tite flexible conduits, NEMA-rated weatherproof junction boxes connectors shall be utilized for exterior camera locations.

3.3 CONNECTIONS

- A. For equipment furnished under this Division of the specifications, provide all Division 28 connections necessary so that the equipment is fully operational upon completion of the project.
- B. Ground equipment according to manufacturer's recommendations.

3.4 FIELD QUALITY CONTROL

- A. Verify that the electronic security system work is installed according to the Contract Documents. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents. Perform additional inspections to determine compliance of replaced or additional work.
- B. Manufacturer's Field Service: The SSI shall provide a qualified technician and/or factory-authorized service representative to inspect, test, and adjust security electronic security system components and equipment installation, including connections, and to assist in field testing.
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After the security electronic system has been energized, perform an operational test of the system to verify compliance with the Contract Documents.
 - 2. When test results indicate that electronic security work does not comply with the Contract Documents, the SSI shall diagnose and correct the deficiencies.
 - 3. Retesting: At the SSI's expense, test and adjust electronic security system head-end equipment and field devices. Replace damaged and malfunctioning equipment.
- D. Remove and replace malfunctioning equipment and retest as specified above.

3.5 ADJUSTING/SCHEDULED MAINTENANCE

- A. SSI shall provide initial electronic security system configuration and adjustments. All field devices and head-end equipment shall be adjusted for optimum performance.
- B. Occupancy Adjustments: The SSI shall provide two (2) scheduled, on-site preventative maintenance/adjustment visits during the warranty period. During these visits, the SSI shall make any necessary adjustments to the electronic security system and replace/repair any defective equipment and/or workmanship found. The duration of each visit shall be a minimum of 4 hours. Each visit shall be documented in a maintenance log and shall be presented to the Owner.

3.6 SYSTEM TESTING

- A. Prior to the shipment of the PLC and GUI control systems to the project site, the SSI shall provide a full system test of all security electronic control system equipment. All control system hardware head-end equipment, including all PLC input and output points, shall be tested with the GUI software and Security Management system. The SSI shall make all necessary software modifications/corrections based on the results of the testing. The control systems shall be re-tested after the software modifications/corrections have been made.
- B. At a minimum of 30 days prior to the shipment of the control system equipment to the project site, the SSI shall notify the Owner that the control system equipment is tested and ready to be demonstrated. This demonstration shall be conducted at the site of the SSI. During the demonstration, the SSI shall coordinate with the Owner to make any programming/configuration changes to the system. These changes may include minor changes to the layout and text on the GUI screens, based on the operational requirements of the Owner.

3.7 DEMONSTRATION

- A. Provide qualified and/or manufacturer-certified personnel to train Owner's maintenance personnel to adjust, operate, and maintain the electronic security system. Refer to Division 01 Section "Demonstration and Training".
- B. Provide demonstration and instruction sessions to familiarize Owner's operation and maintenance personnel with systems and their operation and maintenance.
- C. Establish agendas for demonstration and instruction sessions in conjunction with the Architect and Owner. Coordinate scheduling of sessions with the Architect and Owner.
- D. Provide two 8-hour seminars to demonstrate operation of the systems.
- E. Provide two 8-hour technical seminars to demonstrate configuration, troubleshooting, repair and maintenance of the system.
- F. Training shall be video recorded.

END OF SECTION 280500

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SECTION 316400 – ENGINEERED AGGREGATE PIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 311000 “Site Clearing” for temporary erosion and sedimentation control measures
- C. Section 312000 “Earth Moving”

1.2 SUMMARY

- A. Section includes ground improvement by installation of engineered aggregate piers (ground improvement).
 - 1. Includes installation, monitoring, and testing of the engineered aggregate piers.
 - a. Alternative methods will be considered, and specifications for producing equivalent or better results to meet the performance criteria based on soil conditions identified within the soils investigation report.
 - b. The Contractor along with their ground improvement contractor are responsible to determine an implement the systems and criteria to ensure that the specified performance is achieved as designed by their delegated designer.

1.3 REFERENCED STANDARDS

- A. Design: The Contractor and ground improvement installer shall be responsible for providing the delegated design of the ground improvement system that meets the allowable bearing capacity, and settlement requirements stated herein. Industry recognized standards or design methods specific to the installer’s equipment and construction methods shall be used.
- B. ASTM D1586 Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils
- C. ASTM D5778 Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site or other location as agreed upon by all parties involved.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For engineered aggregate piers, prepared by or under the supervision of a qualified professional engineer.
 - 1. Identify each column and indicate dimensions, cross sections, locations, and sizes.
- C. Delegated Design Submittal: For engineered aggregate piers, submit delegated design submittal for approval prior to beginning the Work covered in this section. Calculations shall be prepared by or under the supervision of a qualified professional engineer.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency, professional engineer, and installer.
 - 1. Professional engineer (Delegated Designer) shall have errors and omissions design insurance for the work. The insurance policy shall provide a minimum coverage of \$2 million per occurrence.
- B. Engineered aggregate pier work schedule: include major milestones and date of completion.
- C. Engineered aggregate pier quality control plan and procedures.
- D. Daily ground improvement progress reports: Furnish a complete and accurate record of engineered aggregate pier installation to the Contractor. The record shall indicate the column location, length, average lift thickness and final elevations of the base and top of columns. The record shall also indicate the type and size of the densification equipment used. Immediately report any unusual conditions encountered during installation to the Contractor, Installer, Construction Manager, Designer and Special Inspector and Quality Control Agency.
- E. Daily quality control records.

1.7 CLOSEOUT SUBMITTALS

- A. Record Drawings.
- B. Certified Survey: Submit within seven days of engineered aggregate pier installation completion.
- C. Report documenting the observations and results of the tests. This report shall certify that the indicated bearing pressure has been achieved within settlement tolerances.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1077, ASTM D 3740, and ASTM E 329 for testing indicated.
- B. Installer Qualifications: Installer shall have a minimum of 5 continuous years of experience with projects of similar scope and complexity.
 - 1. Provide a list of at least five previously completed projects of similar scope and complexity. The list shall include a description of the project, relative size, and reference person with phone number.
 - 2. The installer shall have sufficient competent experienced personnel and proven methods and equipment to carry out the ground improvement to meet the performance criteria.
- C. Professional Engineer Qualifications (Delegated Designer): Currently licensed in the State of Indiana and specializing in the design and detailing of engineered aggregate piers.
 - 1. Provide a list of at least five previously completed projects of similar scope and complexity. The list shall include a description of the project, relative size, and reference person with phone number.
 - 2. The delegated designer shall have sufficient competent experienced personnel to carry out the ground improvement design to meet the performance criteria.

1.9 FIELD CONDITIONS

- A. Protect structures, underground utilities, and other construction from damage caused by engineered aggregate pier excavation.
- B. Site Information: A geotechnical report has been prepared for this Project and is referenced elsewhere in the Project Manual for information only.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for engineered aggregate piers. Before excavating, lay out each engineered aggregate pier to lines and levels required. Record actual measurements of each as-built pier location, diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
 - 1. Record and maintain information pertinent to each engineered aggregate pier and indicate on record Drawings. Cooperate with Owner's testing and inspecting agency to provide data for required reports.
- D. Existing Utilities: All above and below ground utilities shall be located, clearly marked, and relocated as necessary prior to installation of aggregate pier elements. Contractor shall employ a private utility locate company as required to complete utility locates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer (SSE), as defined in Section 014000 "Quality Requirements," to design piles, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
1. Maximum allowable net bearing pressure for engineered aggregate pier reinforced soils = 5000 psf.
 2. Minimum engineered aggregate pier area coverage shall be as determined by the SSE.
 3. Maximum long-term settlement <1 inch.
 4. Maximum long-term differential settlement < 1/2 inch.
 5. Design life of the structure shall be considered to be 50 years.

2.2 MATERIALS

- A. Aggregate: Unless otherwise required by delegated designer, stone shall be used for engineered aggregate piers. The backfill stone shall consist of relatively hard, angular to subangular durable rock fragments, with the size of particles in the range of 1/8 inch to 1-1/2 inches. A gradation meeting the No. 57 (ASTM C33) criteria is acceptable.
- B. Water: Potable water shall be used where water is required.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, and other hazards created by drilling operations.
- B. Rough grade ground elevation at column locations to a minimum of 12 inches above required cutoff elevation.

3.2 EQUIPMENT

- A. Appropriate equipment required by proprietary engineered aggregate pier installer.
- B. Machines shall have the necessary capability to complete work.

3.3 EXCAVATION

- A. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.

- B. Drilling Tolerances:
 - 1. Location: Pile centers maximum 6 inches from locations indicated.
 - 2. Plumb: Within 2 percent from vertical.
 - 3. Batter Angle: Within 4 percent from required angle.

- C. The Contractor shall coordinate all excavations made subsequent to the completion of the ground improvement systems with the installer and delegated designer so that subsequent construction does not impact the installed ground improvement system.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Contractor shall engage a qualified full time special inspector to perform the following special inspections:
 - 1. Shall monitor installation procedures relative to these specifications and shall confirm that subsurface conditions across the installation area as revealed by the pier drilling are in general agreement with the project geotechnical explorations.

- B. The installer of the engineered aggregate pier system shall provide a full time Quality Control (QC) representative on-site during pier construction to maintain QC records during pier installation. This work shall be conducted under the supervision of a registered professional engineer employed by the pier delegated designer.

- C. Contractor's inspector and installer's quality control representative shall be of independent organizations.

- D. The Contractor shall maintain his own quality control for the engineered aggregate pier system construction under the direction of the installer and their delegated designer. The Contractor shall perform all testing required by the work plan and quality control plan.

- E. The installer shall be responsible for design of a verification program to assure the quality of the construction. The program shall verify that the installed ground improvement system satisfies the performance requirements noted in addition to the delegated designer's requirements. This shall at a minimum include:
 - 1. Proposed means and methods for verification that the installed system meets the strength and performance requirements.
 - 2. Proposed quality control program to verify that the ground improvement system is installed in accordance with the delegated designer's design, specifications and these requirements.

- F. A Daily Engineered Aggregate Pier Progress Report shall be completed by the installer during each day of installation, and shall consist of the following:
 - 1. Date of installation and summary of installation equipment and installation procedures.
 - 2. Pier location, length, diameter and identification as indicated on the Shop Drawing.
 - 3. Planned versus actual pier diameter.

4. Size and type of densification equipment used.
 5. Planned versus actual top and bottom elevations.
 6. Average lift thicknesses.
 7. Final top centerline location and deviations from requirements.
 8. Soil and groundwater observations.
 9. Type and size of equipment used.
 10. Date and time of starting and completing.
 11. Automatic monitoring equipment record.
 12. The results of any field Quality Control testing or deflection monitoring done.
 13. Remarks, unusual conditions encountered, and deviations from requirements.
 14. Other items as noted by delegated designer.
- G. Certified engineered aggregate piers Survey: Prepared by a qualified land surveyor or professional engineer showing final location of columns in relation to the property survey and existing benchmarks.
1. Notify Architect when deviations from locations exceed allowable tolerances.
- H. Engineered aggregate piers will be considered defective if they do not pass tests and inspections.
- I. Prepare daily quality control records, tests, inspections, and photographic documentation. Records shall be maintained by the Contractor for all test results, measurements, and inspections performed.

3.5 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 316400