PART 1 - GENERAL

1.1 WORK INCLUDED

1.1.1 Furnish and install all necessary labor, materials, tools and equipment to perform and completely finish the work according to the intent of this specification, and the accompanying drawings.

1.1.2 Furnish and install any incidental work which can reasonably be inferred as required and necessary to provide complete and workable systems.

1.1.3 Provide connections of all equipment specified under these sections and other Divisions including Divisions 22 (Plumbing) and 23 (HVAC) including installation and connection of all motors, relays, remote starters, etc.

1.1.4 The requirements of the General and Supplemental Conditions, and Division 01 apply to Divisions 26, 27 and 28, and these specifications. All sections in Divisions 26, 27, and 28 are interrelated. Work specified in other sections, as applicable, shall apply to all work hereunder.

1.2 LOCAL CONDITIONS

1.2.1 Examine site; verify dimensions and locations against drawings and become informed of all conditions under which work is to be done before submitting proposal. No allowance will be made for extra expenses because of omission on Contractor's part to include cost of work under prevailing conditions.

1.2.2 Information shown relative to services is based upon available records and data shall be regarded as approximate only. Minor deviations found necessary to conform with actual locations and conditions shall be made without extra cost.

1.2.3 Extreme care shall be exercised in excavating near existing utilities to avoid any damage thereto. It shall be the contractor's responsibility to verify existing underground utilities prior to digging anywhere. Information provided on these plans indicating existing conditions shall only be used as reference, and shall not be deemed considered accurate. Any damage to existing utilities done by the contractor shall be repaired and/or replaced by the contractor at their expense to its pre-damage condition.

1.3 PERMITS AND INSPECTIONS

1.3.1 Obtain and pay for all permits and service charges required in installation of the work. Arrange for required inspections and secure approvals from authorities having jurisdiction.

1.3.2 During its progress, work shall be subject to inspection by Project Inspector.

1.4 CODES AND STANDARDS

1.4.1 Work and materials shall be in full accordance with California Occupational Safety Health Act (CAL-OSHA), California Electrical Code (CEC), State Fire Marshal, Electrical Safety Orders (Title 8, Subchapter 5), the National Fire Protection Association, California Building Code (CBC); California Code of Regulations - Title 24 and other applicable State or local laws or regulations. Nothing in the Drawings or Specifications shall be construed to permit work not conforming to these codes.

1.4.2 Electrical materials shall be listed, labeled, or certified for its use by a Nationally Recognized Testing Laboratory such as Underwriter's Laboratories (UL), Factory Mutual (FM), etc.

1.4.3 Materials and components shall conform to Industry Standards, including:

NEMA - National Electrical Manufacturer's Association

ANSI - American National Standards Institute

ASTM - American Society for Testing Material Association

IPCEA - Insulated Power Cable Engineer's Association

CBM - Certified Ballast Manufacturers

1.4.4 When Contract Documents differ from governing codes, furnish and install larger size or higher standards called for without extra charge.

1.5 REVIEW OF MATERIALS

1.5.1 Prior to commencement of Work and within 35 days after award of contract, submit for approval in accordance with General Conditions all equipment and materials to be furnished.

1.5.1.1 Equipment/Product submittals shall be bound and indexed and shall include a table of contents listing all equipment submitted. The table of contents shall include: Project designation, submittal number, submittal name including specification section, date, and include manufacturer, model number, reference specification paragraph or sheet detail number, description, and page location. Where a group or series of products are submitted, each item do not have to be listed, only the series need to be identified. Example:

Project:
Submittal No.
Submittal Name:
Date:
Spec para.,

Page(s)	Manufacturer	Model No.	Detail No.	Description
1-12	**XYZ Corp**	**123ABC**	**2.05**	**Control panel**
13, 14	**XYZ Corp**	**456DEF**	**2.06-A**	**Power supply**
15	**ABC Corp**	**789GHK**	**A/E9.5**	**Rack**
16, 17	**Cantex**	**PVC-40**	**2.01**	**PVC conduit**
18	**Steel City**	**XYZ series**	**2.02**	**Steel fittings**

1.5.1.2 Shop drawings submittals shall be neat and professionally done using CAD (computer aided drafting), hand-drawn submittals will not be accepted. Shop drawings shall have sufficient information to clearly indicate work to be performed and be complete including device/equipment locations, wire sizes, wire types and number of wires, symbol list or legend, point-to-point connections, wiring diagrams, and equipment anchorage detail where needed. Shop drawings shall utilize the same size paper as the Bid set of plans.

1.5.2 Substitutions:

1.5.2.1 Only one (1) request for substitution will be considered on each item of material or equipment. No substitutions will be considered thereafter. Substitutions will be interpreted to be all manufacturers other than those specifically listed by model or catalog number. Should the original submittal of a proposed substitution be rejected, the specified item shall be furnished.

1.5.2.2 Submit complete information or catalog data to show equality of equipment or material offered to that specified. Identify which product is being substituted in the specifications and/or the plans and provide analysis as indicating either it "Complies" or that it "Does Not Comply" and providing a reason. Each Specification paragraph shall be provided with this analysis. No substitutions will be allowed unless requested and approved in writing. Materials of equal merit and appearance, in the opinion of the Engineer, will be approved for use. Engineer reserves the right to require originally specified item.

1.5.2.3 Acceptance of a substitute is not to be considered a release from the Specifications. Any deficiencies in an item, even though approved, shall be corrected by the Contractor at his expense.

1.5.2.4 Responsibility for installation of approved substitution is included herein. Any changes required for installation of approved substituted equipment shall be made without additional cost to Owner.

1.5.3 Where it is in the best interest of the Owner, Engineer may give written consent to a submittal received after expiration of designated time limits, or for an additional resubmittal.

1.5.4 Submit for approval in ample time to avoid delay of construction, shop drawings or submittals on all items of equipment and materials covered in list mentioned above. Submit in accordance with General Conditions in a complete package; partial submittals will not be considered.

1.5.5 Failure to comply with any of the preceding requirements will necessitate that the specified materials be submitted and supplied.

1.6 RECORD DRAWINGS

1.6.1 Upon completion of Work, furnish Engineer with AutoCAD file, PDF file, and one (1) printed full size hardcopy upon which shall be shown all Work installed under contract including any Work which are not in accordance with Original Contract Drawings. AutoCAD files shall be 2004 or later version, with external references bound to its parent drawing. Provide a separate PDF file for each sheet, do not combine all sheets into a single file. Furnish digital files on a USB flash drive or CD.

1.6.1.1 The above shall also include shop drawings.

1.6.2 All symbols and designations used in preparing Record Drawing shall match those used in Contract Drawings.

1.6.3 Show all buried and concealed conduit, stub-outs, etc. Locate all buried conduit and stub-outs by dimensions from permanent, easily located and identifiable portions of structure; also, dimension ends of stub-outs, etc. Note depth of buried items below grade.

1.7 ADDENDA AND CHANGE ORDERS

1.7.1 Changes in the plans and specifications shall be made by Addenda or Change Orders signed by the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 Materials mentioned herein or on drawings require that each item listed be provided and of quality noted, or an approved equal. All material shall be new, full weight and standard in all respects and in first-class conditions. Where possible, all materials used shall be of the same brand or manufacturer throughout for each class of material or equipment.

2.1.2 Grade or quality of materials desired is indicated by trade names or catalog numbers stated herein. Dimensions, sizes and capacities shown are a minimum and shall not be changed without permission of Engineer.

PART 3 - EXECUTION

3.1 DRAWINGS AND COORDINATION

3.1.1 Examine Drawings and Site; be familiar with types of construction where electrical installation is involved. Work shall be neatly installed in a workmanlike manner in accordance with NECA Standard of Installation. Work shall be coordinated with other trades to avoid conflicts. Clarifications will be made by Engineer and minor adjustments shall be made without additional cost to Owner. Obtain ruling from Engineer concerning any obvious discrepancies or omissions in work before bidding. All work involved in correcting obvious errors or omissions after award of Contract shall be performed as directed by Engineer without additional cost to Owner.

3.1.2 Layouts of equipment, accessories and wiring systems are diagrammatic (not pictorial), but shall be followed as closely as possible. Drawings and Specifications are for assistance and guidance, and exact locations, distances, levels, etc., will be governed by Site.

3.1.3 All equipment (devices, conduits, boxes, etc.) shall be flush or semi-flush mounted unless otherwise noted. Where conditions do not allow flush mounting and where acceptable to the Architect, equipment may be surface mounted.

3.2 WORKING SPACE

3.2.1 Provide adequate working space around electrical equipment in compliance with Article 4 of Electrical Safety Orders. In general, provide 36 inches minimum clear work space in front of panelboards and controls of 120/208 volt systems and 42 inches minimum for 277/480 volt systems.

3.3 CARE AND CLEANING

3.3.1 All broken, damaged or otherwise defective parts shall be repaired or replaced without additional cost to Owner. Work shall be left in a condition satisfactory to Engineer. At completion, carefully clean and adjust all equipment, fixtures and trim installed as part of this work. Systems and equipment shall be left in a satisfactory operating condition.

3.3.2 All surplus materials and debris resulting from this work shall be cleaned out and removed from site; this includes surplus excavated material.

3.4 EXCAVATING AND BACKFILLING

3.4.1 Excavate and backfill as required for installation of electrical work. Restore all surfaces, roadways, sod, walks, curbs, walls, existing underground installation,

etc., cut by installations to original condition in an acceptable manner. Maintain all warning signs, barricades, flares and lanterns as required by the Safety Orders and local ordinances.

3.4.2 Excavation: Dig trenches straight and true to line and grade, with bottom clear of any rock points. Minimum conduit depth of pipe crown shall be 24 inches below finished grade.

3.4.3 Backfill: Support conduits with 2 inch sand bedding at bottom of trench. Provide sand backfill from bottom to 12 inches below finished grade. The top 12 inches to be local fine earth material free of rubble, rubbish or vegetation. Trenches shall be backfilled and compacted to 90 percent (per ASTM D1557) of maximum dry density at optimum moisture content in layers not to exceed 6 inch when compacted.

3.5 PROTECTION

3.5.1 In performance of work, protect work from damage. Protect electrical equipment, stored and installed, from dust, water or other damage.

3.6 EQUIPMENT IDENTIFICATION

3.6.1 Panelboards, remote control switches, terminal boxes, etc., shall be properly identified with a descriptive nameplate. Nameplate shall be made of 3/32 inch laminated plastic with black background and white letters. Size of letters shall be 1/4 inch high for equipment in device box or boxes 12 inches or smaller, and 1/2 inch high for panelboard, terminal can, or larger items. Letters shall be machine engraved. Punched strip type nameplates and cardholders in any form are not acceptable. Nameplates shall be attached with oval head machine screws tapped into front panel.

3.6.2 Indicate type of equipment and equipment designation, ex. "PANEL-XXX", "MAIN SWITCHBOARD-XXX", "TRANSFORMER-XXX", "SIGNAL-XXX", "TV-XXX", "EF-1", "AC-1", etc.

3.7 RUST INHIBITOR

3.7.1 Channels, joiners, hangers, straps, clamps, brackets, caps, nuts and bolts and associated parts shall be plated electrolytically with zinc followed immediately thereafter by treating freshly deposited zinc surfaces with chromic acid to obtain a surface which will not form a white deposit on surface for an average of 120 hours when subjected to a standard salt spray cabinet test, or shall be hot dipped galvanized.

3.8 EQUIPMENT PADS

3.8.1 Concrete reinforced pads for mounting of equipment (i.e. switchboard, transformers, freestanding panels, etc.) shall be minimum 3,000 psi, 6 inch thick with No. 4 rebars at 12 inches on center each way. Rebars shall be centered in pad. Pad shall extend beyond equipment to create a safe working space. And

1.5 inch above surrounding area. Backfill and compact to 95 percent maximum dry density at optimum moisture content in layers not to exceed 6 inches when compacted.

3.9 EQUIPMENT ANCHORAGE

3.9.1 Seismic Anchorage of Electrical equipment shall conform to the regulations of CBC-2016 and ASCE 7-10, sections 13.3, 13.4, and 13.6. All equipment shall be braced or anchored to resist a horizontal force acting in any direction using the following criteria:

3.9.1.1 The total design lateral seismic force shall be determined from section 1613A California Building Code (CBC) 2016 and 13.3 ASCE 7-10. Forces shall be applied in the horizontal directions, which results in the most critical loadings for design.

3.9.1.2 The value of Ap (component amplification factor) and Rp (component response modification factor) of section 13.3.1 ASCE 7-10 shall be selected from section 13.6-1 ASCE 7-10. The value of Ip (seismic importance factor) shall be selected from 13.1.3 ASCE 7-10.

3.9.2 Where anchorage details are not shown on the drawings, the field installation shall be subject to the approval of the structural engineer and the field representative of the Office of the State Architect.

3.10 ARC FLASH

3.10.1 Electrical equipment such as switchboards, panelboards, load centers, motor control centers, industrial control panels, meter centers shall be field marked to warn persons of potential electric arc flash hazards per CEC 110.16 and NFPA 70E Standard for Electrical Safety in the Workplace. Minimum label wording shall be as follows:

DANGER
Arc Flash and Shock Hazard.
Appropriate PPE Required.
Do not operate controls or open doors without appropriate
personal protection equipment.
Failure to comply may result in injury or death.

3.11 TEST

3.11.1 Test all wiring and connections for continuity and grounds; where such test indicate faulty insulation or other defects, locate, repair and retest. Balance loads at panelboards. Furnish all testing equipment.

3.12 CLOSING OF AN UNINSPECTED WORK

3.12.1 Do not allow or cause any of work installed hereunder to be covered up or enclosed before it has been inspected and approved.

3.12.2 Should any work be enclosed or covered up before it has been approved, uncover such work and after it has been inspected and approved, make all repairs necessary to restore work of others to conditions in which it was found at time of cutting, all without additional cost to Owner.

3.13 WARRANTY

3.13.1 All materials and installation shall be provided with a one (1) year warranty which shall include replacement parts, labor, retesting, and travel to and from the job site. The warranty period shall begin after final acceptance of the project. The warranty shall cover but is not limited to the following:

3.13.1.1 Defective workmanship and installation.

3.13.1.2 All System components, devices, conduit, wires, etc.

3.13.1.3 Manufactured items such as light fixtures, receptacles, switchboard, panelboard, transformer, switches, etc.

3.13.1.4 Basic materials such as conduit, wires, boxes, cabinets, etc.

3.13.2 Certain manufactured items will have longer warranty periods. Refer to specific item and specification section for warranty information and terms.

3.14 SPARE PARTS AND SPECIAL SERVICE AGREEMENTS

3.14.1 A minimum of 5 percent attic stock on Electronic lighting Control devices such as power packs, relays, occ sensors, wall switches, daylight sensors, plug load controllers, photocells, ETC.

3.14.2 Mechanical and Electrical systems that require regular, very specific maintenance to be performed To insure their proper operation, funds should be Included in the bid package to cover the cost of regular maintenance intervals by outside specialist For the expected life of the equipment. A specific Example would be back-up power systems.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

1.1.1 The work of this Section consists of basic materials and methods for all work included under Divisions 26, 27, and 28. Additional specifications requirements for electrical work are specified under other sections of Divisions 26, 27 and 28 and where those requirements differ from the requirements of this Section, they shall govern.

1.2 SUBMITTALS

1.2.1 Submit product data per Section 26 00 00.

PART 2 - PRODUCTS

2.1 CONDUIT

2.1.1 Rigid Steel Conduit: Standard weight, mild steel pipe, zinc coated on both inside and outside by a hot dipping or sherardizing process. Inside and outside of conduit shall be finished with a protective coating. All threads galvanized after cutting. Meets UL 6, UL Card No. DYIX, and ANSI C80.1.

2.1.2 Intermediate Metallic Conduit (IMC): Intermediate weight, mild steel pipe, meeting same requirements for finish and material as rigid steel conduit. Meets UL 1242, UL Card No. DYIX, and ANSI C80.6.

2.1.3 Electrical Metallic Tubing (EMT): Cold rolled steel tubing, hot-dipped galvanized, with zinc coating on outside and protective lubricating coating on inside. Fittings shall meet same requirements for finish and material as EMT. Meets UL 797 and ANSI C80.3.

2.1.4 Flexible Conduit: UL Listed. Flexible steel, zinc coated on both inside and outside by hot dipping or sherardizing process. Liquid-tight conduit shall be galvanized with extruded polyvinyl covering and with watertight connectors, sunlight resistant, direct burial rated. Flexible steel conduit less than ½ inch shall not be used except that 3/8 inch shall be permitted in lengths not in excess of 6 feet as part of a listed assembly or for tap connections to lighting fixtures as required in CEC Section 410-67(c). Flexible conduit to be one continuous length, no couplings. AFC Liquid-Tuff Type-LFMC and AFC Reduced Wall Flexible Steel Conduit, or equal.

2.1.5 PVC Conduit:

2.1.5.1 Type 40, 90 degree C, UL listed, composed of polyvinyl chloride, conforming to NEMA TC-2, Fed Spec WC1094A, UL651 Standards. Material shall have minimum tensile strength of 6,500 psi at 73.4°F, flexural strength of 12,500 psi and compressive strength of 9,000 psi per ASTM testing. PVC conduit shall be suitable for direct burial without

concrete encasement. Fittings shall be of same manufacture. All joints shall be solvent welded.

2.1.5.2 Type 80, similar to type 40 except with extra heavy wall.

2.1.5.3 Only manufactured elbows/bends shall be used. Where field bends have to be made, obtain prior approval by the engineer.

2.1.6 Raceway Fittings:

2.1.6.1 Rigid Steel Conduit: Fittings, such as couplings, connectors, condulets, elbows, bends, etc., shall be subject to same requirements as for rigid steel conduit. Couplings and unions shall be threaded type, assembled with anti-corrosion, conductive anti-seize compound at joints made absolutely tight to exclude water. Connectors shall be threaded hubs with bonding insulated metallic bushings. Unions shall be equal to Crouse Hinds UNY or UNF.

2.1.6.2 IMC: Fittings shall be as specified for rigid steel conduit.

2.1.6.3 EMT: Fittings shall be steel, box connectors shall have insulated throat. Connectors and couplings to be compression type.

2.1.6.4 Flexible Metallic Conduit: Connectors to be insulated. Metallic connectors (except for liquid-tight) shall be steel "squeeze" type via a screw, Steel City XC-90X and XC-49X series. Liquid-tight metallic connectors shall be watertight approved for such use.

2.1.6.5 Bushings: Metallic insulated type. Weatherproof or dust-tight installations; liquid-tight with sealing ring and insulated throat, OZ/Gedney type "KR".

2.1.6.6 Expansion and Deflection Fittings: OZ/Gedney, Type "DX" or accepted equal.

2.1.6.7 All box connectors to be insulated throat type.

2.1.6.8 Conduit Straps: Galvanized steel, 2-hole straps. 1-hole straps may be used for conduit sizes 1 inch and smaller concealed in wall or above ceiling.

2.1.6.9 PVC Conduit: Fittings shall be same grade of material as conduit, solvent welded to conduit.

2.1.7 Metallic conduits, raceways, and fittings shall be listed and approved as a grounding means.

2.1.8 Hand dryers: Hand dryers to be Excel-BW-110-120V.

2.2 BOXES

2.2.1 Galvanized one-piece or welded pressed steel type. Boxes for fixture shall not be less than 4 inches square and shall be equipped with fixture stud. Boxes shall be at least 1-1/2 inch deep, 4 inch square for 1 or 2 gang devices, with plaster rings and gang box with gang cover. Boxes mounted in wall or ceiling finished with gypsum board shall be furnished with 3/4 inch deep plaster rings. Use screws and not nails to support/secure outlet boxes. Provide blank cover plates for all boxes without devices.

2.2.1.1 1-gang and 2-gang outlet and junction boxes installed exposed outdoors shall be weatherproof type FS, FD, WS, WD die cast metal or aluminum boxes, Appleton or equal. Plug all unused hubs.

2.2.1.2 Provide an equipment grounding pigtail at all receptacle, switch, and device outlet boxes. Ground conductor size to match circuit overcurrent protection complying with CEC.

2.2.1.3 Outlet boxes for data, telecommunications, video, and TV outlets shall be 4 11/16 inch square x 2.125 inch deep.

2.2.1.4 Outlet boxes containing No. 8, No. 6, or No. 4 AWG wires shall be a minimum 2.125 inch deep per CEC.

2.2.2 Junction boxes located outdoors, or in wet or damp locations shall be rated NEMA-3R, with hinged door and pad-locking tabs.

2.2.3 Floor boxes shall be one-gang or multi-gang recessed, fully adjustable with brass lids, cover plates, rings, flanges, etc. for respective tile or carpet floor finish, meet UL514A & UL514C scrub water exclusion requirements for tile and carpet floors. For carpet floors, provide with carpet flange. For "hard" floors such as tile or wood, the top of the cover shall be flush with the top of the finished floor. Receptacle covers shall have individual flip-lids with screw lock. Junction boxes shall have screwed on plugs.

2.2.3.1 Grade level or below: Watertight and concrete-tight of cast iron construction, Walker 880CS series or equal.

2.2.3.2 Above grade level: Concrete-tight of stamped steel construction, Walker 880S series or equal.

2.2.3.3 Raised wood floors: Steel box, Walker 880W series or equal.

2.2.4 Equipment furnished by other trade but require electrical connection shall be provided with appropriate backbox.

2.3 WIRES

2.3.1 Wire shall be copper only, manufactured by General Cable Co., Rome, General Electric Co., or Anaconda. Wire shall be rated 90 degrees C for both dry and wet

locations, THWN-2, XHHW-2, or RHW-2 insulation. 90 degrees C THHN may be used in dry and damp locations. Wire installed in high temperature areas, including branch circuits in or above roof insulation or in fluorescent ballast channel, shall have type RHW-2 or XHHW-2 90 degree insulation.

2.3.1.1 Feeders sized No. 2 and larger routed below grade, extending beyond or outside the building foundation line shall use types XHHW-2, THW-2, or RHW-2 insulation, 90 degrees C dry and wet rated.

2.3.2 Wire shall be Code type copper wire of not less than 98 percent conductivity. All Wires shall be stranded. Wires shall bear the Underwriters' label, be color coded and be marked with gauge, type and manufacturer's name on 24 inch centers. Wires smaller than No. 8 may be stranded. Where stranded wire is used, provide solid pigtail for connection to screw terminals of receptacles, switches, etc.

2.3.3 Color coding to be as follows:

	208/120 Volts	480/277 Volts
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Natural Grey
Ground	Green	Green

Switch legs shall use the same branch circuit phase color coding which they are connected to. IG ground wire shall be green with yellow tracer.

2.3.4 Bring wire to job in original unbroken packages. Obtain approval of inspector or Engineer before installation of wires.

2.4 WALL SWITCHES

2.4.1 Shall be "AC" rated, heavy duty, quiet type, rated 20 amperes at 277 volts A.C. Application of switches shall comply with CEC Section 380-8. Handles shall be bakelite; color shall be compatible with adjacent wall finish. Switches to be as follows:

Manufacturer	Single Pole	3-Way
A & H	1991	1993
Hubbell	1221	1223
P & S	20AC1	20AC3
Leviton	1221	1223

2.4.2 Weatherproof light switches shall have lever switch covers of die cast construction with gasket and gray finish. Hinged flip-lids are not acceptable.

2.5 CONVENIENCE OUTLETS

2.5.1 Shall be "Specification" grade rated 15 amperes at 125 volts, duplex, composition base with slots to accommodate parallel plug caps with grounding peg. Contact shall grip both sides of plug prongs. Where only one (1) receptacle is connected to a 20 ampere circuit, a 20 ampere receptacle shall be used. Outlet shall be UL listed. Receptacles to be Hubbell or equal.

2.5.1.1 15 Amp: Hubbell 5262 series Heavy Duty Industrial Grade, 8200 series for Hospital Grade.

2.5.1.2 20 Amp: Hubbell 5362 series Heavy Duty Industrial Grade, 8300 series for Hospital Grade.

2.5.1.3 Other designations as noted below:

2.5.1.3.1 Ground Fault:	GFR
2.5.1.3.2 Tamper Resistant	TR
2.5.1.3.3 Weather Resistant:	WR
2.5.1.3.4 Isolated Ground:	IG

2.5.1.4 Leviton 5252, 5352, 8200, and 8300 series can be considered equal.

2.5.1.5 Pass & Seymour 5252, 5352, 8200, 8300 series can be considered equal.

2.5.2 Provide devices with matching plates. Isolated ground (IG) receptacles shall be orange with matching color plate. Hospital grade receptacles shall have a distinctive "green" dot. GFI receptacles shall have a visible (light) indicator. Controlled receptacles shall be permanently and visibly marked with the universal power symbol and the word “CONTROLLED”.

2.5.3 All 15 and 20 Amp, 125V and 250V non-locking receptacles (NEMA 5-15, 5-20, 615, 6-20) located outdoors and/or in damp or wet locations shall be listed weather resistant type. Weather resistant receptacles shall be the same grade or class as 15A and 20A receptacles specified above.

2.5.4 Weatherproof covers for receptacles in wet locations shall be rated as weatherproof whether or not a plug is inserted (NEMA-3R), minimum 3.25 inch clearance from front of receptacle, metallic cast type with hinged lid and padlocking hasp, Leviton or equal. Weatherproof covers for receptacles in damp locations shall be rated as weatherproof when attachment plug is removed, with metallic cast cover and flip lids with padlocking hasp.

2.5.5 Provide a separate GFI duplex receptacle at each location identified on the drawings and as specified. Through wiring is not acceptable. Receptacles located at the following locations shall be GFI type, whether indicated in the plans or not.

2.5.5.1 In elevator control rooms.

2.5.5.2 In elevator pits/shafts.

2.5.5.3 In bathrooms or restrooms.

2.5.5.4 Outdoors, on the exterior of the building, and on/above the roof.

2.5.5.5 In commercial and institutional kitchens, unless dedicated to specific equipment.

2.5.5.6 Within 72 inches from any sink or basin such as in a small kitchen, lunch/break room, and the like.

2.5.6 Provide an equipment grounding jumper (pigtail) connecting the grounding terminal of the receptacle to the grounded box.

2.6 PANELBOARDS

2.6.1 Panelboards shall meet NEMA AB-1, PB-1, PB1.1, PB1.2. Panelboards shall be type NQ, NEHB, I-Line, Power-R-Line, A-Series, and CCB as specified for secondary utilization voltage and phase. As manufactured by Square-D, CutlerHammer/Eaton, General Electric, or approved equal. Square-D has been used for design purposes. Busses shall be copper. Provide with neutral buss and copper ground buss. Series rated equipment are not acceptable. Panels shall have full height fully rated bussing. UBC/CBC Seismic Rated.

2.6.2 Circuit breakers shall be bolt-on type thermal magnetic, single-pole and multipole for branch circuit control with trip-rating permanently marked on the handle. Where trip-rating is not marked on the handle, provide engraved label adjacent to the breaker indicating amperage rating. Multi-pole breakers shall be common trip type with single handle. Factory assembled and listed multi-pole breakers with handle ties shall be acceptable. Bails will not be accepted except where used with multi-wire branch circuits through fluorescent lighting fixtures. All circuit breaker handles shall be equipped with padlocking tabs, "lock-off" device. All circuit breakers shall be fully rated to withstand the available short circuit current as designated on the drawings. Series rated equipment will not be acceptable.

2.6.2.1 Circuit breaker frames of 300A to 600A shall have the following field adjustable settings; Long-Time PU, STPU, STD, GFPU, Inst. PU. Breakers shall be solid state with field adjustable rating plugs, or of the electronic type.

2.6.2.2 Circuit breaker trip frames over 600A and less than 1200A shall have the same features as the 300A frames, plus with field replaceable trip units/plugs,

2.6.2.3 Circuit breakers frames of 1200A and higher shall be solid state electronic type with full function trip units including the following field adjustable settings; LTPU, LTD, STPU, STD, Inst PU, Inst OFF, GFPU, GFD.

2.6.3 Enclosures shall be code gauge, galvanized metal with front trim and hinged door with lock master keyed. Front trim shall be equipped with concealed trim clamps and concealed door hinges. Enclosures shall be rated NEMA-1 at dry indoor locations, and NEMA-3R where located outdoors in damp or wet locations. Lighting and appliance branch circuit Panelboards shall be maximum 20 inch wide and 6 inch deep. Panel trim and cabinet shall be finished ANSI-49 or ANSI 61 gray, except panel cabinets to be recessed are not required to be painted. Surface cabinets shall be without knockouts. Inside door shall have frame for circuit identification card. Fill out card, typewritten, with list of circuits corresponding with the circuit number. Identification shall be specific with room designation, type of load, etc, (i.e., "Classroom 214 receptacles"). For distribution panels, provide engraved laminated labels for load served where identification card is not provided.

2.6.4 Panelboard submissions shall include; ladder diagram, physical dimensions and weight, electrical data and ratings, numbering and trip rating of each circuit breaker, accessories, etc. Panelboard shall bear the UL label of approval.

2.6.5 Panelboard types as indicated on the drawings shall be the minimum size and type. Provide a larger size and type of panelboard as necessary for the breakers and features/accessories as indicated.

2.6.6 Circuit breaker arrangement shall be per the panel schedule.

2.6.7 Panel nameplate label shall identify panel, minimum AIC rating, and equipment it is fed from, example as follows, "PANEL-XXX, MAX. 22,000 AIC, FED FROM YYY". Where fed via a transformer, it shall read, "PANEL-XXX, MAX. 14,000 AIC, FED FROM YYY THRU TRANSF-ZZZ". Label shall be engraved plastic per section 26 00 00. 1/2 inch letters for panel identification.

2.6.8 At existing Panelboards where existing loads, circuits, circuit breakers, spaces etc. are changed or affected.

2.6.8.1 Update circuit directory where existing loads, circuits, circuit breakers, spaces etc. are changed or affected. Replace existing directory card with new card, fill out card, typewritten, with list of circuits corresponding with the circuit number. Identification shall be specific with room designation, type of load, etc, (i.e., "Classroom 214 receptacles"). For distribution panels, provide engraved laminated labels for load served where identification card is not provided.

2.6.8.2 Circuit breakers added shall match existing type and AIC rating of panel. Provide necessary hardware.

2.6.9 Panelboards used for disaggregation of loads where more than one (1) load type is in the panel shall have these additional requirements.

2.6.9.1 Comply with CA Title-24 Part-6 for Disaggregation of Electric Circuits.

2.6.9.2 Common buss.

2.6.9.3 Disaggregated loads by Breaker Blocks, each sized from 6 to 42 circuits.

2.6.9.4 Additive/Subtractive metering option per breaker blocks.

2.6.9.5 100 Amp maximum branch circuit breakers.

2.6.9.6 Future space for CT's for each breaker block.

2.6.9.7 Space for main metering including main metering CT's.

2.6.9.8 UL 67, UL50 Listed.

2.6.9.9 UBC/CBC seismic rated.

2.7 SAFETY/DISCONNECT SWITCHES

2.7.1 As a minimum, all switches to be provided with padlocking tabs and be lockable in the “open” position. Label switch with circuit identification per section 26 00 00, example "AC-1, HD1-24".

2.7.2 Type "HD" Heavy Duty safety switches with externally operated handle. Switches shall be manufactured by Westinghouse, General Electric, Square D, or approved equal. Switches shall be rated 250 and 600 volts, A.C., of size and poles as shown on Drawings and as required. Disconnects used outdoor shall be in NEMA-3R. Provide fused switches with proper sized fuses where required by equipment manufacturer. All switches shall have pad-locking cover with interlocking cover. Switches shall have pad-lockable tabs, lockable in both the ON and OFF positions.

2.7.3 For 120V and 277V fractional horsepower motors, disconnect switches can be heavy duty horsepower rated toggle switches or motor control switches.

2.8 INDIVIDUAL CIRCUIT BREAKERS

2.8.1 Circuit breakers shall be molded case thermal magnetic type with trip rating as scheduled on drawings.

2.8.1.1 Circuit breaker frames of 300A to 600A shall have the following field adjustable settings; Long-Time PU, STPU, STD, GFPU, Inst. PU. Breakers shall be solid state with field adjustable rating plugs, or of the electronic type.

2.8.1.2 Circuit breaker trip frames over 600A and less than 1200A shall have the same features as the 300A frames, plus with field replaceable trip units/plugs.

2.8.1.3 Circuit breakers frames of 1200A and higher shall be solid state electronic type with full function trip units including the following field adjustable settings; LTPU, LTD, STPU, STD, Inst PU, Inst OFF, GFPU, GFD.

2.8.2 Circuit breakers shall be quick-make, quick-break, trip free operation. The trip free mechanism shall be independent of manual handle control. All circuit breakers shall be fully rated to withstand the available short circuit current as designated on the drawings. Series rated equipment will not be acceptable.

2.8.3 Breakers to be in NEMA-1 (indoor) or NEMA-3R (damp, wet, and outdoor) enclosures. NEMA-3R enclosures shall have the handle concealed behind the cover, and the hinged cover shall be provided with padlocking tabs. Each circuit breaker shall be identified with an engraved, laminated phenolic plate showing the load served or the function of the circuit breaker and trip rating. The nameplate shall be attached with oval head machine screws tapped into the front of the board. Equip breaker handles with padlocking "lock-off" devices.

2.9 PULL LINE

2.9.1 Furnish and install pull line in all unused (empty) raceways. Pull lines shall not rot or mildew.

2.9.1.1 Conduits up to 1.5 inch: 1/8 inch diameter braided line of polypropylene with 200 lbs. tensile strength, IDEAL, Jet-Line No. 232, or equal.

2.9.1.2 Conduits 2 inches or larger: 3/16 inch polypropylene pull rope with 800 lbs. tensile strength, IDEAL Pro-Pull or equal.

2.9.2 Provide pull line in conduits for utility company systems, size and type per their requirements.

2.10 ACCESS DOORS

2.10.1 Milcor, Newman or equal with concealed hinges, screwdriver locks, prime coated with rust inhibitive paint, and style of door to suit ceiling or wall construction, including fire rating. Access doors in acoustical tile ceilings shall be Hi-Hatch with tile recess. Doors shall be 14 gage C.R. steel and shall be 22 inch x 30 inch; 24 inch x 24 inches in tile ceilings, unless otherwise noted or required.

2.11 PRECAST CONCRETE PULLBOXES/HANDHOLES

2.11.1 Boxes shall be size as indicated on the drawings. Design loads shall consist of live, dead, impact, hydrostatic, and other loads. Live loads shall be for H-20 and/or H-20-S16-44, or as required, per A.A.S.H.O. standard specifications for highway bridges with revisions. Design loads shall be 16 KIPS. Concrete shall be per ASTM-C-33-64. Lightweight concrete shall conform to ASTM-C-3364T. Cement shall be Portland Cement meeting ASTM-C-150 Type II standards. Compressive strength shall be minimum 4,000 psi at 28 days.

2.11.2 Larger Boxes (48 inch x 30 inch or larger): Precast high-density reinforced concrete with end and side knockouts, pulling-in irons. Minimum 4 inch wall thickness. Coordinate size of thin wall knockouts with manufacturer for conduit entry. Acceptable manufacturers shall be Forni, Christy or equal.

2.11.3 Smaller Boxes (smaller than 48 inch x 30 inch): Precast high-density reinforced concrete with end and side knockouts, and extension as required. Minimum 1.5 inch wall thickness. Extensions shall be grouted. Acceptable manufacturers shall be Forni, Christy or equal.

2.11.4 Covers: Larger box covers, in other than concrete paving areas, shall be one or multi piece as required, steel checker plate, galvanized with anti-slip surface rated for parkway loading, with hold-down bolts. All other box covers shall be reinforce concrete with hold down bolts. Where susceptible to vehicular traffic, use H-20 rated traffic cover. All covers shall be factory marked, see drawings for marking/label required. If not noted, use the following markings:

SYSTEM	MARKING
Power 600 volts or less	Electrical
Power over 600 volts	Danger High Voltage-Keep Out
Telephone	Telephone
Clock, Unified Signal, etc.	Signal
Fire Alarm	Fire Alarm
Television	T.V.
Lighting	Lighting
Grounding	Ground

2.11.5 Installation:

2.11.5.1 Excavate around area to accept box, a minimum of 4 inches around all sides for ease of installation. Provide 12 inches of compacted pea gravel for bedding and/or to facilitate drainage.

2.11.5.2 Backfill shall consist sand or fine earth, compacted. Saturated soil or large rocks shall not be used. No voids shall remain between walls and native soil.

2.11.5.3 Grout and seal all joints conduits at box entry with cement. Provide End Bells on conduits.

2.11.6 Utility Co. boxes shall be per their requirements. Provide with ground rod as required.

2.11.7 The metal covers of pull boxes with power or lighting conductors shall be ground bonded to the feeder or branch circuit equipment grounding conductor(s) in the pull box.

2.11.7.1 All of the equipment grounding conductors in the pullbox shall be ground bonded together using the largest grounding conductor in the box or grounding terminal.

2.11.7.2 Ground bond the metal cover to the other ground conductors using the largest ground conductor in the pullbox.

2.11.7.3 Other grounding methods are allowed where submitted and approved.

2.12 BACKBOARDS

2.12.1 Backboards shall be 3/4 inch plywood, type A-C grade fire treated for interior use, and type Exterior Grade for outdoor use. Backboards located outdoors shall be provided with one (1) coat primer and two (2) coats of exterior paint. Backboards in terminal cabinets shall be same as for interior use.

2.13 TERMINAL CABINETS

2.13.1 Terminal, relay, and contactor cabinets shall be code gauge, size as indicated with appropriate trim for mounting as indicated, with hinged door and cylinder type locks. NEMA-1 for indoor use in dry areas and NEMA-3R for outdoor use or in wet locations. Surface mounted cabinets shall not have knockouts. Provide backing plate/board for mounting equipment. Circle A-W or equal.

2.13.2 Provide engraved plastic label per section 26 00 00. Label shall identify the type of cabinet and designation, example "FIRE ALARM - FCA" and "EXTERIOR LIGHTING - RA".

2.14 LIGHTING CONTACTORS

2.14.1 Contactors shall be UL listed, rated minimum 30 amps at 120/277/480 Volts, electrically operated, for all types of lighting loads. Short circuit withstand rating shall exceed maximum available short circuit amps. Coil voltage shall match control voltage. Square-D class 8903 type LO (electrically held) and LXO (mechanically held) or equal.

2.14.2 Contactors shall be installed on vibration isolators in Relay cabinets appropriately sized.

2.15 GROUND RODS

2.15.1 Ground rods shall be 3/4 in dia. x 10 ft. copper clad steel.

2.16 SURGE PROTECTIVE DEVICE (SPD)
(Transient Voltage Surge Protector TVSS)

2.16.1 Where indicated at main service entrance, provide internally mounted SPD, Square-D SurgeLogic, Eaton Cutler-Hammer, G.E. or equal. Where internal mounting is not practical provide externally mounted with close nipple connection, Leviton 57000 Series or equal.

2.16.1.1 Minimum surge current rating: 160 kA per phase.

2.16.1.2 Clamping performance rating per UL1449 3rd edition:

Mode	120/208V	480/277V
L-N	400V	800V
L-G	400V	800V
N-G	400V	800V

2.16.2 Where indicated at panels and other than main service locations, provide internally mounted SPD, Square-D SurgeLogic, Eaton Cutler-Hammer, G.E. or equal. Where internal mounting is not practical provide externally mounted with close nipple connection, Leviton 52000 Series or equal.

2.16.2.1 Minimum surge current rating: 100 kA per phase.

2.16.2.2 Clamping performance rating per UL 1449 3rd edition:

Mode	120/208V	480/277V
L-N	400V	800V
L-G	400V	800V
N-G	400V	800V

2.16.3 SPD devices shall be Listed and Component Recognized in accordance with:

2.16.3.1 UL 1449 Third Edition.

2.16.3.2 UL 1283.

2.16.3.3 NEMA LS-1 (1992) Low Voltage Surge Protective Devices.

2.16.3.4 ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits, Category-C.

2.16.3.5 ANSI/IEEE C62.45, Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.

2.16.3.6 Comply with CEC Article 285.

2.16.4 The SPD shall be rated to withstand the available fault current.

2.16.5 Noise rejection at 50 Ohms, 5K - 100 MHz dB = -20 to -40.

2.16.6 Maximum Continuous Operating Voltage (MCOV) shall be at least 115 percent of the nominal voltage. MOV's to be minimum 34mm diameter.

2.16.7 Features shall include clamping envelope tracking, parallel-operated, built-in redundancy provides complete protection on all phases, modular design allowing replacement of modules, normal mode and common mode protection for WYE

configured 3-phase systems, fuse protection for each module. Limited 5-year warranty.

2.16.8 The preferred method is to have the SPD unit internally mounted, which is either mounted directly to switchboard/panel bussing or within its enclosed compartment. Where external mounted unit is used, provide metal enclosure with hinged metal cover. External units shall be installed directly adjacent to panel it is protecting using close nipple connection. Provide in NEMA-3R cabinet where installed outdoors. Approx. size of 15.1 inch H x 13.1 inch W x 5.2 inch D.

2.17 SURFACE METALLIC AND NONMETALLIC RACEWAYS

2.17.1 The surface raceway system for branch circuit wiring and/or data network, voice, video and other low-voltage wiring shall be manufactured by the Wiremold Company, or equal. Raceway series as indicated on the plans. The raceway and all system components must be UL listed and exhibit non-flammable self-extinguishing characteristics. The raceway shall be a two-piece design with a base and a snap-on cover.

2.17.1.1 The nonmetallic raceway base and cover shall be manufactured of rigid PVC compound, available in ivory or white color. Exposed cuts shall be covered with cover clips.

2.17.1.2 The metal raceway base and cover shall be manufactured of galvanized steel, ivory finish and suitable for field painting.

2.17.2 A full complement of fittings must be available including, but not limited to flat, internal and external elbows, tees, entrance fittings, boxes, covers, adapters, cover clips, and end caps. The fittings shall match the base and cover, and be of matching colors. All fittings shall be supplied with a base where applicable to eliminate mitering. A transition fitting shall be available to adapt to other Wiremold series raceways. Field cuts shall be clean, straight, and true with no rough edges.

2.17.3 For multicompartment raceways, device brackets shall be available for mounting standard devices in-line or offset from the raceway. A device bracket shall be available for mounting up to four devices at one location. Faceplates shall match and fit flush in the device plate and shall overlay the cover and base to hide uneven cuts. They shall match the raceway base and cover. The raceway manufacturer will provide a complete line of connectivity outlets and modular inserts for UTP (i.e. data jacks), STP (150 ohm), Fiber Optic, Coaxial and other cabling types with face plates and bezels to facilitate mounting.

2.17.4 Work shall include furnishing all raceway and appropriate fittings and device plates to install a nonmetallic surface raceway system. Installer shall comply with detailed manufacturer's instruction sheets, which accompany system components as well as system instruction sheets. No single compartment non-metallic raceway for circuits over 100v.

2.17.5 Non-metallic raceway systems shall not be used in Assembly areas and other areas where the system is not rated for the installation. Assembly areas include but not limited to; gymnasiums, multipurpose rooms, auditoriums, conference rooms, etc.

2.18 COVER PLATES

2.18.1 Switch and receptacle cover plates shall be smooth nylon type. Cover plates for other devices/outlets such as data, telephone, television, etc. shall be nylon. Cover plate color shall be ivory, matching all systems.

2.18.2 For multi-purpose rooms, gymnasiums, kitchens, locker rooms, toilet/restrooms, and walls such as CMU, brick, concrete block, and concrete walls, device plates shall be smooth stainless steel with beveled edges.

2.18.3 Each receptacle shall have its circuit identification on the cover plate (i.e., "LA112"). Use typewritten "clear tape". Use black letters/numbers for light colored (white, almond, tan, beige, etc.) cover plates. For darker colored cover plates (black, brown, gray, red, etc.), tape to be white with black letters/numbers. Tape shall be located at the lower portion of the cover plate. Clean surface before adhesive tape is applied, and wrap tape (approx. 1 inch) at each end around back side of each cover plate.

2.18.3.1 For floor boxes, plates shall be engraved with circuit identification.

2.18.3.2 For light switches, use same circuit identification method as for receptacles.

PART 3 - EXECUTION

3.1 CONDUITS AND CIRCUITS

3.1.1 All conduits shall be rigid steel or IMC except EMT may be used at following locations:

3.1.1.1 In dry locations in concealed furred spaces.

3.1.1.2 In partitions other than concrete, concrete block, or solid masonry.

3.1.1.3 For exposed work indoors and outdoors above 10 ft except:

3.1.1.3.1 In special locations prohibited by Code, such as hazardous locations, rigid steel shall be used.

3.1.1.3.2 Conduits exposed on/above the roof shall be rigid steel up to 10 ft above roof surface.

3.1.1.3.3 Conduits exposed in Gymnasiums and Multi-Purpose Rooms shall be rigid steel up to 25 ft.

3.1.1.3.4 Concealed above suspended ceilings or ceilings directly attached to structure above.

3.1.2 Flexible conduit: Shall be used to provide flexible connections of short length (3 ft or less) to equipment subject to vibration or movement and to all motors. Up to 6 ft is allowed where additional flexibility is needed. Provide a separate bonding conductor in all flexible connections/conduit. Flexible conduit shall be one continuous length without couplings.

3.1.2.1 Secure flex conduit within 12 inches of each box, cabinet, conduit body, or other termination, and maximum 4.5 ft on center. Refer to the CEC for other secure lengths where flexibility is required or in other specific instances.

3.1.3 Run conduit concealed in areas having finished ceilings and in walls. Run all cross conduits and vertical risers or drops concealed in wall and/or partitions. Should it be necessary to notch any framing members, make such notching only at locations and in a manner as approved by the Architects. Where concealing conduit is not possible or practical, conduit may be run exposed in areas only where so permitted by the Architect. Install exposed conduit run neatly, parallel to or at right angles to structural members. Maintain a minimum of 6 inches clearance from steam or hot water pipes.

3.1.4 Support conduit with straps and secure to wood structure by means of bolts or lag screws, to concrete by means of insert or expansion bolts, to brickwork by means of expansion bolts, and to hollow masonry by means of toggle bolts. Expanders and shields shall be steel or malleable iron.

3.1.5 Do not install in concrete slabs.

3.1.6 Conduits installed in contact with ground shall be PVC-40 conduit.

3.1.6.1 Provide a minimum 2 inch of sand bedding at the bottom of the trench before laying conduits. Maintain 2 inch separation between conduits. Maintain 12 inches separation between power conduits (120 Volts and greater) and low voltage signal conduits.

3.1.6.2 Backfill shall be sand, from bottom to 12 inches below finished grade. Fine earth native backfill to be used for the last 12 inches.

3.1.6.3 Risers, including elbows, shall be double-wrapped rigid steel or PVC coated rigid steel conduit; except that risers, including elbows and bends, at in-ground pull box locations shall be PVC-40 terminated with endbells.

3.1.6.4 When installing underground conduits to specified depth, depth shall be taken from the top of the conduit to the finished grade level. Unless otherwise specified, underground conduits outside of foundation line shall be installed with top side not less than 24 inches below finished grade.

3.1.6.4.1 Conduits 1.5 inch and larger inside foundation line shall be below subgrade.

3.1.6.4.2 Conduits 1.25 inch and smaller inside foundation line shall be installed on the subgrade, only one conduit high. Conduits shall cross under subgrade. Secure conduit to subgrade to prevent "floating".

3.1.6.4.3 Backfill material within foundation line shall be sand.

3.1.6.5 Utility Company (electric, telephone, cable TV, etc.) conduits shall be installed per their depth and backfill requirements. Minimum depth shall be 24 inches below finished grade. Minimum conduit shall be PVC-40. Where the utility company allows use of a "lesser" grade conduit, i.e. DB120, PVC-40 shall be used.

3.1.6.6 The minimum size of conduits outside the foundation line shall be 1 inch, 3/4 inch inside the foundation line.

3.1.6.7 Bends shall be wide sweeping type with minimum 24 inch radius bends.

3.1.6.8 Manufactured elbows are required to be used for all 22.5 and 45 degree bends, and 90 degree elbows, and combinations thereof. Field bends may be used for other bends with approved field benders specifically for such purpose and such bends shall not compromise the integrity and nominal thickness of the conduit wall.

3.1.6.9 For all trenches, provide a 6 inch wide non-biodegradable metal-detectable polyethylene tape at 12 inches below grade, 5-mil thick, labeled "CAUTION ELECTRIC LINE BURIED BELOW". Fluorescent red for electric power conduits and fluorescent orange "TELECOMMUNICATIONS" for telephone and signal conduits. Use Fluorescent red for common trenches. Tape shall be continuous for full length of trench.

3.1.7 Support individual conduits with 2-hole steel straps. 1-hole steel straps may be used for conduits 1 inch and smaller concealed in wall or above ceilings.

3.1.8 Galvanized iron hanger rods sizes ¼ inch diameter and larger with spring steel fasteners, clips or clamps specifically designed for purpose for conduits up to 1 inch size may be used.

3.1.9 Individual conduits ¾ inch and smaller run above wire suspended ceilings may be supported from independent hanger wires with approved spring steel clips. Wire ties will not be acceptable. Wire shall be taut and secured to ceiling and structure above.

3.1.10 Support multi-parallel horizontal conduit runs with trapeze type hangers consisting of two or more steel hanger rods, cross channels, J-bolts, clamps, etc.

3.1.11 Sizes of rods and cross channels shall be designed to support four times actual load. Hanger rods shall have safety factor of 5 based on ultimate strength of material used.

3.1.12 Conduits for data, telecommunications, signal, video, TV, and/or containing fiber optic, coaxial, or OSP (outside plant) multi-pair cables shall have a minimum inside bend radius per CEC Table 346-10 (do not use exception); except that conduits 2 inches to 4 inches shall be minimum 24 inches radius bends.

3.1.13 After installation of conductors, all conduits routed below grade shall be sealed at each opening, including risers and in pull boxes, to prevent the entrance of water and debris.

3.1.14 Relocatable (Portable) Buildings:

3.1.14.1 Where building is not secured to a permanent foundation, conduits connecting to Portable Buildings, shall be installed so as to allow 12 inches of building movement in all directions. Conduit riser shall extend to approximately 4 inches above ground 12 inches from the building, continuing with a flexible conduit connection to the panel, cabinet, junction box, etc.

3.1.14.2 For ease of disconnection for interior conduits, provide flexible conduit connection through junction box between building modules.

3.1.15 Conduit stubs: Conduits not terminated into a box or cabinet, such as stubbed to a backboard or above ceiling, shall be terminated with an insulated bushing. Bushings for metallic conduits shall be metallic type secured by set screw, compression, or threaded type. Bushings for PVC conduits shall be glued in place. Stubs above ceiling shall be turned 90-deg so the end is horizontal facing to prevent the entry of debris.

3.1.16 Although circuiting is shown as diagrammatic, their point-to-point destinations and their indication of above/below ground route shall be followed as much as possible. Where site conditions dictate that an alternate means of routing will alleviate conflicts, the alternate means will be considered with prior approval by the Engineer.

3.1.17 Where cinder fill is encountered in Block walls, conduit shall be PVC-40 where in contact with cinder fill. Boxes shall be PVC type where in contact with cinder fill.

3.1.18 EMT conduit circuits installed on the roof, if allowed by the Engineer, shall have a ground conductor routed with the circuit conductors sized per the circuit protective device.

3.1.19 Horizontal runs of conduit above suspended wire lay-in ceilings shall not be less than 12 inches above the ceiling.

3.1.20 Maintain 12 inch separation between power circuits (>120V) and all signal circuits (data, telephone, speaker, clock, etc.) to prevent interference.

3.1.21 Feeder conduits connected to panels/switchboard shall have ground lug bushing connected to equipment ground buss with ground wire same size as largest ground wire in the panel/switchboard.

3.1.22 Conduits penetrating through the roof shall be secured within 12 inches below roof and supported within 12 inches of the penetration on the roof.

3.1.23 Where conduits cross building expansion/seismic joints provide a short length of flexible conduit (do not exceed 6 ft.) and fittings listed as a grounding means, or in locations where flex conduit cannot be used provide UL listed expansion/seismic fittings.

3.1.24 Conduits concealed in any masonry shall be routed in a conduit sleeve. Such sleeves shall not be placed closer than 3 diameters, center to center.

3.1.25 Conduits to air conditioning (AC) equipment, fans, or other roof mounted equipment shall rise up from the ceiling below through the equipment curb or conduit window within the equipment, if allowed by equipment manufacturer, to prevent additional roof penetrations.

3.1.26 Where conduit passes through finished walls or ceilings, provide steel escutcheon plates, chrome or painted as directed. Conduit which penetrate floor slabs, concrete or masonry walls shall be grouted and sealed watertight at penetrations.

3.1.27 For 20-amp 120 or 277 Volt circuits using 90-deg C wires:

3.1.27.1 Do not install more than three (3) circuits in any conduit.

3.1.27.2 Do not install more than six (6) current carrying conductors in any conduit.

3.1.27.3 Where using No. 10 AWG wires to allow for conductor derating

3.1.27.3.1 Do not install more than six (6) circuits in any conduit.

3.1.27.3.2 Do not install more than 12 current carrying conductors in any conduit.

3.1.28 Cables and Raceways installed under metal-corrugated sheet roof decking shall maintain a minimum 1.5 inch from the nearest surface of the roof decking per CEC. This shall not apply to RMC or IMC.

3.1.29 Where switches control lighting loads supplied by a grounded branch circuit, the grounded conductor for the controlled lighting circuit shall be provided at the switch location. The grounded circuit conductor can be omitted where exceptions 1 and 2 apply. (CEC 404.2(C))

3.2 CAPPING

3.2.1 Cap conduits during construction with manufactured seals. Swab out conduits before wires are pulled in.

3.2.2 Cap all empty conduits below grade and in pull boxes with manufacturer's caps to prevent entrance of water and debris, attach pull string to cap.

3.3 FLASHING

3.3.1 Make conduit projecting through roof watertight by proper flashing. Secure a sheet lead cap with a tightening bend to conduit. Use two (2) collars for tar or asphalt composition roofings. Set one collar directly on roof deck and second collar set over on top of roofing felts. Lead sheet flashing shall be made of 4 lb. sheet lead. Use Stoneman No. 1100-4 series for individual conduits and No. 910/915 multi-flash for more than on conduit penetration, or equal.

3.4 PENETRATIONS OF FIRE RESISTIVE WALLS AND PARTITIONS

3.4.1 Penetrations of protected openings (fire rated walls, ceilings, floor-ceilings, roofs, etc.) shall be protected in accordance with the California Building Code, Part 2, Chapter 7, Title 24. Penetrations shall apply to conduits (raceways), cable trays, boxes, cabinets, panels, cables, etc.

3.4.2 Fire stopping shall be provided at penetrations of fire resistive walls, floors, ceilings, floor-ceiling assemblies, and roofs. Fire-stopping shall have a "F" and/or "T" rating as determined by tests conducted in accordance with ASTM E 814 or UL-1479. Fire stopping system/materials shall be UL Listed.

3.5 ACCESS DOORS

3.5.1 Furnish and install access doors wherever required whether shown or not for easy maintenance of electrical systems; for example, inaccessible areas and attics containing heat detectors, junction boxes, etc. Access doors shall provide for complete removal and replacement of equipment. Provide fire rated access doors where located in fire rated partitions.

3.6 BOXES

3.6.1 Nails shall not be used to support outlet boxes. Boxes must be accurately placed for finish, independently and securely supported by adequate wood backing or by manufactured adjustable channel type heavy-duty box hangers. For metal stud construction, use metal box hangers only. Box hangers shall be securely tied or welded (where permitted) or screwed to metal studs. Paint weld with rust inhibitor. Boxes installed in masonry tile or concrete block construction shall be secured with auxiliary plates, bars or clips and be grouted in place.

3.6.1.1 Outlet boxes with receptacles or switches: Provide a solid pigtail (green) ground wire grounded to the metallic outlet box. Pigtail shall also ground

device and separate ground conductor if available. Size of ground wire to match overcurrent protection.

3.6.2 Locate outlets at the following heights above floor to the center of the device or handle unless otherwise noted on Drawings or in Specifications.

3.6.2.1 The top of the outlet box shall not be higher than 48 inch above finished floor, and the bottom of the outlet box shall not be less than 15 inch above finished floor. For forward or side approach over counter, maximum 44 inches and 46 inches respectively to top of box.

3.6.2.2 Convenience Outlets: 18 inches (4 inch above counter or splash).

3.6.2.3 Local Switches: 45 inches.

3.6.2.4 Telephone Outlets: 18 inches (45 inches for wall phone).

3.6.2.5 Data, TV Outlets: 18 inches.

3.6.2.6 Where devices are shown at counter locations, they shall be located approximately 4 inch above counter, clearing back-splash where applicable.

3.6.2.7 Refer to elevations and details on Architectural Drawings for exact heights and locations of all electrical outlets for switches, receptacles, special equipment, etc. Where above heights do not suit building construction or finish, consult Architect.

3.6.3 Install pull boxes or junction boxes as required in accessible spaces but do not install in finished areas unless approved by Architect.

3.6.4 Where fire rated construction is required (refer to Architectural Drawings), do not locate electrical outlet boxes back-to-back. Provide a minimum of 24 inches horizontal separation between outlet boxes on opposite side of the same wall. Where such restrictions cannot be met, provide fire-stopping around box such as 3M Moldable Putty Pads or equal.

3.6.5 Boxes up to 100 cubic inches located in suspended wire ceilings may be supported through an independent hanger wire with approved tension clips. Wire shall be taut. Secure wire to the structure above and the ceiling below.

3.7 CONDUCTORS

3.7.1 Splices and joints for No. 10 AWG or smaller wiring shall be twisted together electrically and mechanically strong and insulated with approved type insulated electrical spring connectors Ideal WING-NUT. Joints and connections for No. 8 AWG or larger shall be made with Burndy, T & B, or approved equal, solderless tool applied pressure lugs and connectors. Uninsulated lugs and wire ends shall be insulated with layers of plastic tape equal to insulation of wire and with all irregular surfaces properly padded with "Scotchfil" putty prior to application of

tape. Tape shall be equal to Scotch #33, General Electric No. AW-1, or approved equal. Feeder splicing is not permitted.

3.7.1.1 In special instances where feeder splicing is allowed by the Engineer, it shall be made with high compression sleeve type connector followed by manufactured splicing kit utilizing as insulators, resins poured into a ready-to-use plastic mold to provide a uniform, moisture-proof tough, impact-resistant insulation.

3.7.1.2 Conductor splices below grade shall meet ANSI C119.1-1986 and UL 486D Standards. Raychem WCSM or FCSM heavy wall heat shrink tubing; or RVS or RVC series if use of flame heat is prohibited. Conductors to be joined with compression sleeve connectors.

3.7.2 Use only UL approved wire pulling compound as lubricant.

3.7.3 Lace conductors together with waxed linen lacing cord, T & B "Ty-Rap", Holub "Quik-Wrap" or equal, in a neat and workmanlike manner in panelboards, wireways, raceways, pull boxes and similar locations.

3.7.4 No. 12 AWG wire shall be minimum size wire used for lighting and power circuits. Motor control circuits may be No. 14 except as marked on Drawings, unless shown.

3.7.5 Provide cable supports in risers by means of a clamping device with insulated wedges or "Kellem" grips.

3.7.6 All conductors shall be in conduit unless otherwise indicated.

3.7.7 Conduit sizes shall be based on code fill table for THW insulated wires to accommodate the number, size, and type of wires shown or specified.

3.7.8 Wiring installed in pull boxes or junction boxes, where wire is pulled through without terminations (except splices), shall have a service loop around the interior of the box for 360 degrees utilizing the largest circumference.

3.7.9 Use No. 10 AWG conductor for 20 Amp 120 Volt circuit home runs longer than 75 feet, and for 20 Amp 277 Volt circuit homeruns longer than 200 feet.

3.7.10 Where conductors are increased in size and number (such as for voltage drop reasons), such that conductors will not fit the standard breaker or panel lugs, terminate conductors in one of the following means:

3.7.10.1 Provide larger breaker frame or panelboard.

3.7.10.2 Provide oversized lugs.

3.7.10.3 Last option only with approval from Engineer: Terminate wires in multiport connector and provide pigtail. Splice to be made in panel or

switchboard if space is available, or in separate splice box. This option will not be normally granted.

3.8 PANELS AND CABINETS

3.8.1 Recessed enclosures (panelboards, terminal cabinets, cabinets, control cabinets, etc.) shall be provided with a minimum of three (3) ¾ inch empty conduits stubbed into accessible space above the ceiling. Drawings may require additional conduits.

3.9 GROUNDING

3.9.1 Grounding and ground bonding of the electrical installation shall be in accordance with CEC Article 250, and any applicable codes. Ground fittings shall be approved manufactured type, installed and connected to conform with Code requirements.

3.9.2 Neutral conductors and noncurrent-carrying parts of equipment at each installation shall be grounded in accordance with applicable code. Ground conductor shall be copper having a current capacity sized in accordance with CEC.

3.9.3 All equipment cases, motor frames, etc., shall be completely grounded to satisfy requirements of CEC. Install bond wire in flexible conduit. Install copper bond wire, sized in accordance with CEC, in all nonmetallic raceways and bond to all metallic parts using approved fittings.

3.9.4 Service ground conductor shall be connected to a "Ufer" encased ground and bonded to the metallic cold water pipe system and to the metallic natural gas line.

3.9.5 Interior metallic cold water pipe system and other interior metallic piping systems shall be ground bonded to the building grounding system.

3.9.6 Each building shall be provided with a grounding electrode connected to the metallic enclosure of the building disconnecting means. Grounding electrode conductor shall be sized per CEC table 250-66.

3.9.7 Total ground resistance shall not exceed 25 ohms.

3.9.8 All connections shall be made with solderless connectors or molded fusion welding process.

3.9.9 Equipment grounding conductors shall be insulated with a continuous green outer finish along its entire length. Conductors size No. 4 AWG and larger may be identified (with green electrical tape applied half-lapped) at each end and at every point where the conductor is accessible. Tape shall be applied from its point of entry to point of exit or termination.

3.9.10 Insulated grounded (neutral) conductors shall be identified with a continuous white outer finish along its entire length. Neutral conductors No. 4 AWG or larger

can be identified by a distinctive white marking (applied half-lapped with white electrical tape) for the last 12 inches at each end.

3.9.11 Where equipment is 1000 Volts or above, fence grounding shall be provided per CEC.

3.9.11.1 Provide a ground rod at each corner fence post and at line posts at least every 40 ft. Ground rods to be 5/8" x 8 ft buried below grade.

3.9.11.2 All ground conductors to be minimum No. 2 bare copper. Ground conductor to be buried 30 inches below grade following outside fenced enclosure. Provide ground connections between ground rods, at fence posts, at gate posts, to equipment, etc. for a complete looped system.

3.9.11.3 Each gate post shall be grounded and provide flexible braided copper strap ground connection to gate. Corner gate post shall have a ground rod.

3.9.11.4 Ground equipment rated 1000V or higher to ground conductor.

3.9.11.5 Connections to be exothermic welds or ground clamps rated for such use.

3.9.11.6 Each gate shall be bonded to its gatepost by flexible braided copper strap.

3.10 FIELD TESTS

3.10.1 General: Perform field test in the presence of the Owner's Representative except as otherwise specified. Provide required labor, materials, equipment and connections to perform tests. Document results and submit them to the Owner's Representative. Repair or replace all defective work.

3.10.2 Perform Insulation Resistance (IR) "Megger" Testing per NETA Standards.

Submit test results. Provide testing for:

3.10.2.1 All feeders 100 Amps and higher.

3.10.2.2 Branch circuits 100 Amps and higher.

3.10.3 Verify operation of starters and install overload protection devices sized in accordance with the motor full load current.

3.10.4 Each ground rod shall be tested. A ground rod which does not have a resistance to ground of 25 ohms or less shall be augmented by one additional ground rod at no less than 8 feet from each other. Submit test results.

3.11 CIRCUIT BREAKER COORDINATION

3.11.1 Provide protective device (fuses and breakers) coordination study on the distribution system to determine circuit breaker settings for electronic breakers and other breakers with adjustable tripping characteristics, and all protective devices 300 amps or more. The coordination shall be with the immediate downstream and upstream protective device(s).

3.11.2 Plot time-current characteristics of the specified protective devices using log-log paper. Include the following minimum information, as pertinent to system, on plots:

3.11.2.1 Complete titles.

3.11.2.2 Representation One Line Diagram and legends.

3.11.2.3 Power company's relays or fuse characteristics.

3.11.2.4 Complete operating bands of low voltage circuit breaker trip curves.

3.11.2.5 Fuse curves.

3.11.2.6 Protective relay type selected and curves.

Maintain reasonable coordination intervals and separation of characteristic curves on plots. Provide sufficient curves to clearly indicate the coordination achieved to the main breaker, feeder breakers and load protective devices rated 300 amperes or more.

3.11.3 Summarized the results of the power system study in a bound final report. Organize the report using the following sections:

3.11.3.1 Description, purpose, basis, written scope, and a single-line diagram of the portion of the power system which is included within the scope of study.

3.11.3.2 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.

3.11.3.3 Provide a separate tabulated list for the selection and settings of the protective devices. Include the following minimum information:

3.11.3.3.1 Circuit identification.

3.11.3.3.2 IEEE device number (Where applicable)

3.11.3.3.3 Manufacturer, device type and range of adjustment.

3.11.3.3.4 Recommended settings.

3.12 GROUND FAULT PROTECTION AND TESTING

3.12.1 Where indicated on the plans, provide circuit breaker with ground fault protection. The ground fault system shall include a memory circuit for positive tripping action despite intermittent arcing ground faults.

3.12.2 Provide an integral means of testing the ground fault system to meet the on-site requirements of CEC Articles 230 and 517.

3.12.3 Provide acceptance testing per InterNational Electrical Testing Association Inc. (NETA) specifications and standards. Submit test results.

3.13 CLEANING

3.13.1 Brush and clean work prior to concealing, painting and acceptance. Performed in stages if directed.

3.13.2 Clean and repair soiled or damaged painted exposed work and match adjoining work before final acceptance.

3.13.3 Remove debris from inside and outside of material, equipment and structures.

3.14 WARRANTY

3.14.1 All materials and installation shall be provided with a one (1) year warranty which shall include replacement parts, labor, retesting, and travel to and from the job site. The warranty period shall begin after final acceptance of the project.

END OF SECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

1.1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.1.2 Division-16 or 26, Basic Materials and Methods sections apply to work specified in this section.

1.2 REFERENCE STANDARDS

1.2.1 ANSI/TIA-492.AAAC-B - Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers

1.2.2 ANSI/TIA-492.AAAD - Detail Specification for 850-nm Laser- Optimized, 50-µm Core Diameter/125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers Suitable for Manufacturing OM4 Cabled Optical Fiber

1.2.3 ANSI/TIA-492.CAAB - Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak. Current Edition

1.2.4 ANSI/TIA-568.0-D - Generic Communications Cabling for Customer Premises

1.2.5 ANSI/TIA-568.1-D - Commercial Building Communications Cabling Standard

1.2.6 ANSI/TIA-568-C.2-1 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards

1.2.7 ANSI/TIA-568.3-D - Optical Fiber Cabling and Components Standard

1.2.8 ANSI/TIA-569-D - Telecommunications Pathways and Spaces

1.2.9 ANSI/TIA-606-B.1 - Administration Standard for the Commercial Telecommunications Infrastructure.

1.2.10 ANSI/TIA-607-C - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

1.2.11 ANSI/TIA-862-B - Structured Cabling Infrastructure Standard for Intelligent Building Systems

1.2.12 ANSI/TIA-942-A - Telecommunications Infrastructure Standard for Data Centers

1.2.13 NFPA 70 - National Electrical Code (NEC).

1.2.14 BICSI - TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM)

1.3 GOVERNANCE

1.3.1 The Electrical Code referred to in these specifications is the National Electrical Code as currently adopted by the State of California. All work will be provided in strict compliance with the Electrical Code and all regulations that may apply.

1.3.2 Where standards exist, for a particular category, products used on this project will be listed by an OSHA approved Nationally Recognized Testing Laboratory (NRTL), and be approved or listed for the intended service and application.

1.3.3 These specifications do not undertake to repeat the requirements of codes, regulations or NRTL listing or labeling instructions. The Specifications or Drawings may require items or work beyond the requirements of applicable codes or regulations. The stricter, higher quality, greater quantity or higher cost will be allowed, and accommodations must be approved by Owner prior to procurement or installation. It is incumbent on the Installer, material and equipment suppliers to meet these specifications, applicable codes, regulations, and NRTL listing agency restrictions.

1.3.4 The word "Manufacturer" will include the Manufacturer, the Manufacturer's Representative, the Distributor, the Fabricator, and the Supplier of the particular classification of equipment, system, product, and material.

1.3.5 All work, equipment, and systems will be manufactured, provided, repaired, installed, and tested in accordance with the latest edition and all current amendments of the applicable publications and standards of the organizations listed below as of the date of the Contract Documents. When the Specification requirements exceed the requirements of these publications and standards the Specifications will govern:

1.3.5.1 State Building Code (SBC)

1.3.5.2 Building Department Inspectional Services

1.3.5.3 American Society for Testing and Materials (ASTM)

1.3.5.4 Underwriter's Laboratories, Inc. (UL)

1.3.5.5 Insulated Cable Engineers Association (ICEA)

1.3.5.6 National Electrical Manufacturers Association (NEMA)

1.3.5.7 Institute of Electrical and Electronics Engineers, Inc. (IEEE)

1.3.5.8 American National Standards Institute, Inc. (ANSI)

1.3.5.9 National Fire Protection Association (NFPA)

1.3.5.10 Local Electric Code

1.3.5.11 Department of Public Safety (DPS)

1.3.5.12 Building Officials and Code Administrators International, Inc. (BOCA)

1.3.5.13 Department of Labor USA. Safety and Health Regulations for Construction (OSHA)

1.3.5.14 Energy Codes

1.3.5.15 National Electrical Contractors Association (NECA)

1.3.5.16 National Bureau of Standards (NBS)

1.3.5.17 Federal Communications Commission (FCC)

1.3.5.18 Utilities Serving Project.

1.3.5.19 Fire Department.

1.3.5.20 Americans with Disabilities Act Applications Guidelines (ADAAG).

1.3.5.21 Accessibility Guidelines for Buildings and Facilities.

1.3.5.22 Any and all Federal, State and Local Standards, Codes and Authorities having Jurisdiction.

1.3.6 In addition, all phases of the Structured Cabling System installation will adhere to applicable Local Area Network (LAN) Specifications of the IEEE, Electronics Industry Association/Telecommunications Industry Association (TIA/EIA), and Building Industry Consulting Service International (BICSI). The entire system and all components will be NRTL certified to appropriate TIA/EIA performance rating Category, Latest ANSI/TIA/EIA Standards 455-A, 492, 568, 569-A, 570, 606, 607 and 758 (latest revisions), and ANSI/TIA TSB 67, TSB 72, TSB 75, TSB 95 plus other standards as applicable.

1.3.7 The Installer will have available at the job site at all times one copy of the latest edition of the Electrical Code, TIA and BICSI Standards applicable to the work as specified within this document.

1.3.8 The above requirements will not in any way limit responsibility or requirements to comply with all other codes, standards and laws.

1.3.9 Material, equipment, enclosures, and systems will be designed for use as required to suit the conditions, exterior or interior operation, dust tight, water tight, explosion-proof, or other special types.

1.3.10 All materials shall be purchased from Distributors authorized by system Manufacturers to sell new and unused components.

1.4 DESCRIPTION OF WORK:

1.4.1 The extent of telephone/data system work is indicated and is hereby defined to include, but not be limited to cable, cable supports, raceway, connectors, racks, cabinets, panels, wire management, device plates, patch cords, backboard, grounding, firestop and miscellaneous items required for a complete, tested and operational system.

1.4.2 Provide, install and test the complete cable and outlet system as indicated and described herein. Work includes procurement, project management, installation, labeling, termination, testing and cleanup of all cables installed under this project.

1.4.3 Provide system testing, as-builts (redlines) of installed cables and numbering plan, Operations & Maintenance Manuals (O&M's), and processing of warranty registration with Manufacturer.

1.4.4 Project coordination with General Contractor, Owner, Owners Representative, and other trades before, during and upon completion of project as necessary for a well-executed project.

1.4.5 Refer to other Master Division sections, bid proposal and project responsibilities matrix for responsibility and requirements for raceways, boxes and fittings, wiring devices (plates), and supporting devices, and other sections, as applicable.

1.4.6 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 "permanent link," a term that is used in the testing protocols.

1.4.7 Horizontal copper cabling system consists of four twisted pairs of solid annealed copper. Each four pair cable is terminated onto 8 position 8 conductor ("RJ45", or 8P8C) outlet connectors ("Jacks") using Insulation Displacement Conductors (IDCs). Color-coded connectors are placed into NEMA rated faceplates at the work area and placed into corresponding rack-mounted patch panels in the equipment / networking rooms. The jacks use state-of-the-art techniques to effectively eliminate Alien Crosstalk.

1.4.8 Horizontal cabling may contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.

1.4.9 Bridged taps and/or splices will not be installed in the horizontal cabling.

1.4.10 Communications cables shall be rated CMR (riser) or CMP (plenum). CMP cable ratings are required for cables passing through or contained within plenum air handling spaces, such as above drop ceilings and return or supply air shafts. The Contractor is responsible for installing the correct cable type in the appropriate environment, and any failures to do so according to the Owner

or the Authority Having Jurisdiction (AHJ) will result in the Contractor removing the unsuitable cable and installing the correct cable, at their own expense.

1.4.11 The maximum allowable horizontal cable length installed in the permanent link (jack to jack) is 295 feet (90 m). This maximum allowable length does not include an allowance for patch cords, maximum length of 16 feet (5 m) to the workstation equipment and of 16 feet (5 m) in the horizontal cross-connect.

1.5 QUALITY ASSURANCE:

1.5.1 Comply with applicable portions of NEC as to type products used and installation of components. Provide products and materials, which have been UL-listed and labeled. Comply with NEMA, ANSI and TIA standards manufacturer's recommendations for horizontal cabling.

1.6 SUBMITTALS AND SUBSTITUTIONS

1.6.1 The Owner has standardized on a unified, end-to-end copper and optical fiber cabling system design based on Leviton jacks, patch panels, patch cords, fiber cords, fiber connectors, trunk cables, fiber enclosures and modules, as well as Berk-Tek field-terminable copper and fiber cables. The Owner is satisfied that the products specified herein are qualified for the purpose intended, and has performed due diligence in establishing a consistent set of standards based on performance and feature set.

1.6.2 Products which are proposed in the bid response which are of an alternative solution are to be prequalified as "equal or better" by the Designer and Owner, in writing, prior to bid acceptance. If substitutions are allowed, they are at the discretion of the Owner and based on performance, suitability, quality, administrational requirements, warranty and other factors deemed important to the Owner. Written acceptance of substitutions from Owner must be included in bid package to avoid disqualification of bid.

1.6.3 Submit manufacturer's data and installation details for all devices, plates, cable, terminal blocks, patch cords, racks, wire management, labels and similar equipment which are not in accordance with Owner standards.

1.6.4 Submit a copy of 3rd party testing and certification documents which prove they meet or exceed the requirements as set forth in this document, for any product or system not specified herein or proposed as an "equal" substitute for Owner-approved products. All products must have independent test data published prior to bid.

1.6.5 Any substitutions must be approved by Designer, Owner and/or Owner's Representative in writing prior to acceptance of bid.

1.7 CONTRACTOR QUALIFICATIONS AND TRAINING

1.7.1 The Contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data, voice and imaging network systems. The Contractor shall at a minimum possess the following qualifications:

1.7.1.1 Possess those licenses/permits required to perform telecommunications installations in the specified jurisdiction.

1.7.1.2 Provide references of the type of installation provide in this specification.

1.7.1.3 Personnel trained and certified in fiber optic cabling, splicing, termination and testing techniques. Personnel must have experience using a light meter and OTDR.

1.7.1.4 Personnel trained in the installation of pathways and support for housing horizontal and backbone cabling.

1.7.1.5 Personnel knowledgeable in local, state, province and national codes, and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall be followed.

1.7.1.6 Be in the Low Voltage or Telecommunications Installation business for a minimum of ten (10) years. If project is in California, Contractor must possess a current California C7 or C10 license. Projects in other states must be supported by the appropriate minimum level contractor's license required for the work involved.

1.7.1.7 Be an approved Member in good standing of the Certified Installer network associated with the products listed in this Specification and authorized for use in this Project. Contractor must be a member of this installer program before, during, and through completion of the system installation. Supporting documentation will be required as part of the submittal.

1.7.1.8 Maintain a certified RCDD on staff and utilize manufacturer trained, Union certified, or BICSI certified Installers for this project.

1.8 WARRANTY

1.8.1 A Limited Lifetime Product and Performance Warranty covering all components (cable, jacks, panels, patch cords, equipment, workmanship, etc.) shall be provided to the Owner, submitted in writing with system documentation. The warranty period shall begin on the system's first use by the Owner.

1.8.1.1 Horizontal channels shall be completed with Leviton Network Solutions factory- terminated copper and/or fiber optic patch cords in order to be eligible for the applicable Limited Lifetime Warranty with channel performance guarantees.

1.8.1.2 Approved product shall be listed on the most recent version of the applicable Manufacturer's data sheets for each listed solution.

1.8.1.3 The Contractor must pre-register the project with the Manufacturer before installation has begun. Following project completion, Contractor is responsible for completing all warranty registration procedures on behalf of the Owner.

1.8.1.4 Should the cabling system fail to perform its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the Contractor shall promptly make all required corrections without cost to the Owner.

1.8.2 Certified Installer shall provide labor, materials, and documentation in accordance with Manufacturer requirements necessary to ensure that the Owner will be furnished with the maximum available Manufacturer's Warranty in force at the time of this project.

1.8.3 The installed structured cabling system shall provide a warranty guaranteeing the specified performance in the installed channel performance above the ANSI/TIA-568 requirements for Category 6, and Augmented Category 6 (CAT 6A) cabling systems or ISO 11801 requirements for Class E and Class E_A , respectively.

1.8.3.1 Standards-compliant channel or permanent link performance tests shall be performed in the field with a Manufacturer-approved certification tester in the appropriate channel or permanent link test configuration.

1.8.4 Necessary documentation for warranty registration shall be provided to the manufacturer by the installer (within 10 days) following 100 percent testing of cables.

1.8.4.1 Installation Contractor shall submit test results to Network Connectivity Manufacturer in the certification tester's original software files.

1.8.4.2 Installation Contractor shall ensure that the warranty registration is properly submitted, with all required documentation within 10 days of project completion.

1.8.4.3 Certified Contractor/Integrator must adhere to the terms and conditions of the respective manufacturer's warranty programs.

1.8.5 Manufacturer shall ensure that the Owner receives the project warranty certificate within 60 calendar days of warranty registration.

1.9 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

1.9.1 All conduit and EMT required for Communications cabling pathway in/out of cross connect closets and in/out of wall cavities at the work area. EMT or Conduit for pathways shall have no more than two (2) 90 degree bends between pull boxes and no continuous section over 100 feet.

1.9.2 All core holes through concrete, metal, finished hardwood or masonry; in-floor troughs ("Walker Duct"), and poke through devices in the floor for the installation of Communications cabling. Device plates for landing communication cables should be included in the Communications scope.

1.9.3 All core holes and EMT sleeves between floors for the routing of Communications cabling.

1.9.4 Back boxes for the mounting of NEMA rated faceplates.

1.9.5 Drag line or pull string at the back boxes fished through existing EMT, conduit, or wall cavities ("Ring and String") to the accessible ceiling or other end of conduit, for installing 4 pair, multi-pair or fiber optic (horizontal and backbone) cables.

1.9.6 Minimum of two (2) walls covered in ¾ inch AC grade plywood painted white with fire retardant paint in each cross connect closet or connection point for data, voice, video, security and building automation systems. Plywood walls shall be covered 4 ft W x 8 ft H whenever possible.

1.9.7 Basket tray or ladder racking to support main pathway cable bundles through hallways, open areas or exiting telecom rooms unless otherwise requested at time of bid.

1.9.8 #2/0 ground wire or other size as appropriate, from Telecommunications Grounding Bus Bar(s) to Building Ground. Use of No. 6 ground wire, or smaller as allowed, for grounding of telecommunications equipment installed under this Scope is included within the Telecommunications scope of work.

1.9.9 Electrical subcontractors may be required to provide additional lighting, power or grounding connections to the electrical panel, and to provide and install electrical devices as needed. It will be the responsibility of the Contractor to secure all required specialists and subcontractors in order to fully perform under the requirements for these projects.

PART 2 - PRODUCTS

2.1 GENERAL

2.1.1 Provide complete raceway, outlet boxes and miscellaneous items as required.

2.1.2 Utilize 4-11/16 inch square outlet box (min) at each outlet location with single gang plaster or tile ring and 1 inch conduit to cable tray, backboard, or accessible ceiling or floor space.

2.1.3 Provide a complete data cabling and device system as described herein.

2.1.4 Work area connectors shall be of a non-proprietary "Keystone"-style port configuration, such that they fit into all furniture, panels, wallplates, raceways, floor monuments, poke-throughs and AV boxes without adapters. Maximum

density of 6 CAT6A outlets shall be available in Decora footprint where required, and 48 ports in a 1RU panel may be required in select high density locations.

2.2 ACCEPTABLE MANUFACTURER SOLUTIONS:

2.2.1 Subject to compliance with requirements, provide products of the following:

2.2.1.1 Ortronics

2.2.1.2 Superior Essex

2.2.1.3 Owner Pre-approved equal

2.3 UTP PIN/PAIR TERMINATION ASSIGNMENT

2.3.1 The UTP cabling system will have TIA/EIA T568B pin/pair termination assignment (for all non-residential projects). All conductors provided will be properly and consistently terminated at both ends in the same termination configuration throughout the entire system. Maintain minimum untwist of pairs and jacket removal per TIA, BICSI, and Manufacturer's recommendations.

2.4 SYSTEM PERFORMANCE

2.4.1 Category 6A (CAT6A) Unshielded Twisted Pair (UTP) Systems

2.4.1.1 Category 6A 23AWG UTP copper cabling system shall be guaranteed to exceed all TIA- 568 link and channel performance requirements, and capable of supporting 10GBase-T (802.3an) and ISO/IEC 11801 Class E_A applications for a total distance of 100 meters with equipment cords. System is guaranteed to meet all CAT6A requirements for short links and channels down to a 10 foot permanent link (5 meter channel) with a guaranteed 5 dB margin of Alien Crosstalk. Field testing is not required for Alien Crosstalk clearance.

2.4.1.2 Category 6A UTP Performance Parameters, headroom over TIA-568 standard:

Insertion Loss	NEXT	PSNEXT	ACR-F (ELFEXT)	PSACR-F (PSELFEXT)	Return Loss	ACR-N	PSACR-N	PSANEXT	PSAACR-F
3%	4 dB	5 dB	8 dB	8 dB	4 dB	7 dB	7 dB	4 dB	10 dB

2.4.2 Category 6A (CAT6A) Shielded (F/UTP, or FTP) Systems

2.4.2.1 Horizontal FTP Category 6A 23AWG copper cabling system shall be guaranteed to exceed all TIA-568-C.2 link and channel performance requirements and be capable of supporting 10G Base-T (802.3an) and ISO/IEC 11801 Class E_A applications for a total distance of 100 meters with equipment cords. System is guaranteed to meet all CAT 6A requirements for short links and channels down to a 7 meter link (9 meter

channel) with a guaranteed 16 dB margin of Alien Crosstalk (PSANEXT). Field testing is not required for Alien Crosstalk clearance.

2.4.2.2 CAT6A FTP Performance Parameters, headroom over TIA-568-C standard:

Insertion Loss	NEXT	PSNEXT	ACR-F (ELFEXT)	PSACR-F (PSELFEXT)	Return Loss	ACR-N	PSACR-N	PSANEXT	PSAACR-F
3%	4 dB	6 dB	8 dB	8 dB	3 dB	7 dB	8 dB	16 dB	16 dB

2.4.3 Category 6 (CAT6) Unshielded Twisted Pair (UTP) Systems

2.4.3.1 Category 6 UTP 23AWG copper cabling system shall be guaranteed to exceed all TIA- 568 link and channel performance requirements and be capable of supporting 1000 Base- T (802.3ab) and ISO/IEC 11801 Class E applications for a total distance of 100 meters with equipment cords.

2.4.3.2 CAT6 UTP Performance Parameters, headroom over TIA-568 standard:

Insertion Loss	NEXT	PSNEXT	ACR-F (ELFEXT)	PSACR-F (PSELFEXT)	Return Loss	ACR-N	PSACR-N
3%	6 dB	6 dB	8 dB	9 dB	3 dB	7 dB	8 dB

2.4.4 Category 6 (CAT6) Shielded Twisted Pair (F/UTP, or FTP) Systems

2.4.4.1 Category 6 FTP 23AWG copper cabling system shall be guaranteed to meet or exceed all TIA-568 link and channel performance requirements and be capable of supporting 1000 Base-T (802.3ab) and ISO/IEC 11801 Class E applications for a total distance of 100 meters with equipment cords.

2.4.4.2 CAT6 FTP Performance Parameters, headroom over TIA-568 standard:

Insertion Loss	NEXT	PSNEXT	ACR-F (ELFEXT)	PSACR-F (PSELFEXT)	Return Loss	ACR-N	PSACR-N
2%	5 dB	6 dB	5 dB	6 dB	2 dB	6 dB	7 dB

2.5 HORIZONTAL CABLING SYSTEMS

2.5.1 Category-Rate Data Connectors (RJ45 Jacks)

2.5.1.1 CATEGORY 6A (CAT6A) UTP JACKS: Provide modular type Category SA information outlets for 23-AWG copper cable. These Category 6A (CAT6A) connectors shall be individual snap-in style, and exceed compliance with TIA/EIA-568-C.2 specifications. The connectors shall comply with the following:

2.5.1.1.1 Be 8-position/ 8 conductor (8P8C, RJ45-style) modular jacks.

2.5.1.1.2 Utilize a universal Keystone-style insertion footprint as the manufacturer’s main "flagship" line of products.

2.5.1.1.3 Comply with FCC Part 68; UL listed and CSA Certified. Verified to exceed all channel performance requirements in TIA-568-B.2-10 from 1 MHz to 500MHz to support the IEEE 802.an standard for 10 Gigabit Ethernet over UTP Cable.

2.5.1.1.4 Each 10G connector is to feature an injection molded Cone of Silence™ technology to eliminate alien crosstalk (AXT).

2.5.1.1.5 Every 10G connector to include polymer springs above the tines ("Retention Force Technology" or similar functionality) to promote return of tines to original position and protect against deformation due to stress of patch cords or inappropriate materials insertion.

2.5.1.1.6 Connector shall have Pair Separation Towers on IDC to facilitate quick, easy terminations without a complete untwist of each pair of conductors.

2.5.1.1.7 The connector shall be rear 110-type insulation displacement connectors (IDC) with solder-plated phosphor bronze contacts, configured in a 180 degree orientation such that the punch down field is in the back, allowing for rear termination.

2.5.1.1.8 The connector shall provide a ledge directly adjacent to the 110-style termination against which the wires can be directly terminated and cut in one action by the installation craftsperson.

2.5.1.1.9 Connector wiring label shall provide installation color codes for both T568A and T568B wiring schemes on separate labels.

2.5.1.2 CATEGORY 6 (CAT6) UTP JACKS: Provide modular type Category 6 information outlets for 23/24AWG copper cable. These Category 6 (CAT6) connectors shall be individual snap-in style, and exceed compliance with TIA/EIA-568-C .2 specifications. The connectors shall comply with the following:

2.5.1.2.1 Be 8-position/ 8 conductor (8P8C, RJ45-style) modular jacks.

2.5.1.2.2 Utilize a universal Keystone-style insertion footprint as the manufacturer's main "flagship" line of products.

2.5.1.2.3 Comply with FCC Part 68; UL listed and CSA Certified.

2.5.1.2.4 Termination of all connectors shall be rear 110-type insulation displacement connectors (IDC) with solder-plated phosphor bronze contacts.

2.5.1.2.5 IDC posts shall employ a mechanism to allow for terminations without a complete untwist of each pair of conductors.

2.5.1.2.6 The connector shall provide a ledge directly adjacent to the 110-style termination against which the wires can be directly terminated and cut in one action by the installation craftsperson.

2.5.1.2.7 Connector wiring label shall provide installation color codes for both T568A and T568B wiring schemes on separate labels.

2.5.1.2.8 Jacks shall employ "Retention Force Technology" or similar functionality involving polymer springs above tines for support and longevity of unimpeded physical conductor contacts.

Approved Products:

Ortronics CAT 6 Keystone Jack Ivory OR-K56-13

2.5.1.3 CATEGORY 6 OR 6A, SHIELDED (FTP) OR PLENUM-RATED JACKS: Provide shielded and/or plenum-rated, modular-type, information connectors/outlets (jacks) for 24-23 AWG copper cable when deployed in shielded, ceiling or plenum-rated environments. Provide shielded (plenum rated) connectors (jacks) for terminating any shielded cable. These jacks shall be individual snap-in style, exceed compliance with TIA-568 specifications, and comply with the following:

2.5.1.3.1 Shall be 8-position 8-conductor (8P8C) "RJ45"-style modular jack, Category 6 (CAT6) and/or Category 6A (CAT6A), with IDC terminals, T568A/B wiring scheme (use T568B), and utilize a non-punchdown simplified manual termination style.

2.5.1.3.2 Shall be encased in a die-cast housing to protect from potential EMI/RFI, and utilize a universal Keystone-style insertion footprint as the manufacturer's main "flagship" line of products.

2.5.1.3.3 CAT6A connectors shall exceed all component performance requirements for Augmented Category 6 in the ANSI/TIA-568 standard, as well as Class E_A requirements as described in ISO/IEC 11801, from 1 MHz to 500 MHz to support the IEEE 802.3an standard for 10GBASE-T network performance.

2.5.1.3.4 CAT6 Connectors shall exceed all component performance requirements for Category 6 in the ANSI/TIA-568-C.2 standard, as well as Class E requirements as described in ISO/IEC 11801, from 1 MHz to 250 MHz.

2.5.1.3.5 Shielded connectors shall utilize the same form factor, design, and tool-less installation process as the unshielded connectors in the product line.

2.5.1.3.6 Shall be tested by an Independent testing body such as Intertek (ETL) for component compliance (i.e. "Component rated") to ANSI/TIA-568 and for POE+ applications. Test results shall be published and publicly available without special request.

2.5.1.3.7 Shall be in compliance will all National Electrical Codes; compliant with ANSI/TIA- 1096-A (formerly FCC Part 68); cULus Listed.

2.5.1.3.8 Plenum-rated per UL 2043, and all plastic components shall be made of high-impact, fire-retardant plastic rated UL 94V-0.

2.5.1.3.9 Shall have a maximum depth of 1.31 inch.

2.5.1.3.10 Cable shall be terminated by the use of a snap-on wire manager that holds individual conductors in place during termination, and allows for termination without a complete untwist of each conductor pair. Cables shall terminate onto jack via a "clamshell" closure at rear of connector, affixing termination manager to connector IDC

2.5.1.3.11 Shall be terminated without the need for any punch down tool or other specialized or proprietary termination tool.

2.5.1.3.12 Shall be reusable and support a minimum 20 termination and re-termination cycles and be facilitated by simple termination release levers.

2.5.1.3.13 Shall utilize a method of tine tensioning using polymer springs above the tines ("Retention Force Technology" or similar functionality) that prevents six-position modular plug insertion from damaging either the cord or the module and promotes return of tines to original position.

2.5.1.3.14 Shall fit the full manufacturer's range of telecommunications faceplates, outlets, and field-configurable patch panels. No separate product line or style of connectors shall be required for patch panels, faceplate, biscuit, furniture, raceway and/or floor feed applications.

2.5.1.3.15 Shall be available in 13 TIA-606-B compatible colors and supplied with interchangeable icons (Voice, Data, A/V, and blank, color coded to match the connector face) for easy identification and tracking of data, voice, or other functions. Additional bulk Icons for the connector shall be available separately.

2.5.1.3.16 Shall be available with an optional internal shutter to protect against dust and debris such as in above-ceiling and in-floor locations.

2.5.2 PATCH PANELS

2.5.2.1 Telecommunications Room Patch panels shall be manufactured with empty ports, which allow for the insertion of appropriately-graded and colored jacks. Panels shall be Shielded, standard density, and used for

all CAT6 and CAT6A terminations at IDF and MDF locations. Panels shall be:

2.5.2.1.1 Unshielded for UTP, and Shielded for FTP or FTP/UTP combined applications.

2.5.2.1.2 Shielded panels shall accept both styles (UTP/FTP) of jacks in the same panel, and shall include star washers and grounding lug for flexibility in panel grounding, and/or hardware to accept standards-compliant grounding connectors.

2.5.2.1.3 Available in either 24- or 48-ports 1RU, or 48-port 2RU versions.

2.5.2.1.4 Independently tested and verified by Intertek (ETL) to meet or exceed all TIA component, permanent link, and channel requirements of TIA-568 for CAT 5e, CAT 6, and CAT 6A, FCC part 68, and IEC 60603-7. An appropriate cable management bar shall be included with standard density flat panels.

2.5.2.1.5 QuickPort High-Density modular panels shall be available in 48-ports/1 RU form factors for authorized situations.

2.5.2.1.6 Shall be sized to fit an EIA standard, 19 inch relay rack and hole pattern.

2.5.2.1.7 Shall utilize a universal Keystone-style insertion footprint as the manufacturer's main "flagship" line of products and receive the same jacks as are used in the workstation outlets. No special "Panel jack" shall be required.

2.5.2.1.8 Verify angled or flat panel use per design documentation or verification with Owner's Representative.

2.5.3 FACEPLATES

2.5.3.1 Faceplates (wallplates) secure information outlets to the work area. Contractor shall provide and install single gang faceplate kits to house all jacks as required for all work area outlets, workstation base feeds, and furniture openings. Unused telecom backboxes shall receive a solid blank faceplate. Telecommunications faceplates shall:

2.5.3.1.1 Utilize a keystone ("QuickPort") footprint to match the approved connectivity manufacturer, and be made by the same manufacturer as the connectors.

2.5.3.1.2 Precisely match colors and materials of the power wiring device plates.

2.5.3.1.3 Support any connectivity media type, including fiber, AV and copper applications.

2.5.3.1.4 Have write-on or printable designation labels for circuit identification together with a clear plastic cover.

2.5.3.1.5 Be available in single-gang and double-gang configurations.

2.5.3.1.6 Have surface-mount boxes and standoff rings available for both single and double gang faceplates.

2.5.3.1.7 Have single-port blank inserts to match faceplate color, available in packs of 10.

2.5.3.1.8 Color shall match nearby electrical devices exactly. Off-color ivories or whites will not be accepted.

2.5.3.1.9 Furniture faceplates shall fit existing knockouts for telecom receptacles, and snap in without screw mounts.

2.5.3.1.10 Decora® inserts shall hold from 1 to 6 jacks per device plate.

2.5.4 SURFACE-MOUNT BLOCKS (SMB)

2.5.4.1 Surface-Mount Blocks (SMBs) are used to protect terminated CAT6 and CAT6A cables at the endpoints where they are not contained within walls or furniture. Example locations may be Wireless Access Points (WAPs), Group Work Areas fed by conduits run down columns, security cameras, or other network-enabled device locations.

2.5.4.2 Ceiling, WAP, Camera and other non-wallmount locations will use a 2-port plastic SMB.

2.5.4.3 Small Surface-Mount Boxes shall exhibit the following characteristics:

2.5.4.3.1 Outlet housings for WAPs and other devices shall be a high-density, low profile design with (1) to (12) field-configurable ports, snap-lock cover, and cable knockouts on back.

2.5.4.3.2 Housing cover shall have raceway knockouts for top and bottom entry. Base shall include Tie-wrap anchor points at all cable entrances.

2.5.4.3.3 The housing shall be mountable with screws, tape or a single magnet.

2.5.4.3.4 The cover shall provide the option of securing it to the base with a screw that is hidden under the outlet identification window.

2.5.4.3.5 Shall be constructed of high-impact self-extinguishing plastic rated UL 94V-0, and be UL Listed and compliant with FCC Part 68 and TIA-568 specifications.

2.5.4.3.6 1- and 2-port housings are suitable for installation in air-handling spaces (plenum)

2.5.5 DATA CABLES

2.5.5.1 Category 6A (CAT6A) Unshielded Twisted-Pair (UTP) cable

2.5.5.1.1 100-0hm, 23 AWG, Category 6A 4-pair balanced unshielded twisted pair solid annealed copper.

2.5.5.1.2 Cable shall be characterized to 750 MHz and UL/ETL Listed by the Manufacturer printed on the cable jacket and package, as well as Intertek (ETL) Verified to TIA-568 Category 6A and ISO/IEC 11801 Class E_A requirements for channel, link and component performance to support IEEE 10GBASE-T (802.3an) networks.

2.5.5.1.3 Maximum Cable Outer Diameter: 0.275 inch.

2.5.5.1.4 Documentation available from an independent third-party testing agency that verifies through random sampling that cable components perform at or above the levels contained on their product specifications, not simply at or above the standard.

2.5.5.1.5 Guaranteed cable balance improves overall performance and reduces emissions which results in error-free performance up to 10 Gigabit Ethernet with full duplex transmission.

2.5.5.1.6 The unshielded twisted pair conductors are surrounded by a non-conductive aluminum/polyester tape and jacketed with flame-retardant polymer alloy to reduce alien crosstalk, reduce cable diameter and improve performance.

2.5.5.1.7 Provided on spools or reels-in-box to reduce risk of kinking cable upon deployment

2.5.5.1.8 Cable shall be Plenum-rated (CMP) for any location where plenum cable is required.

2.5.5.1.9 Color: White, or as directed.

2.5.5.1.10 Be made by an ISO 9001 and 14001 Certified Manufacturer.

2.5.5.1.11 Guaranteed to meet or exceed Channel margin guarantees as stated above under System Performance.

2.5.5.2 Category 6A (CAT6A) Shielded, or Foiled Twisted Pair (FTP) cable

2.5.5.2.1 100-Ohm, 23 AWG, Category 6A 4-pair balanced twisted pair solid annealed copper with a single overall foil shield.

2.5.5.2.2 Shielded with an overall polyester/aluminum foil with stranded tinned copper drain wire and ripcord and jacketed in flame-retardant PVC

2.5.5.2.3 Characterized to 750 MHz, 75 degrees C and UL/ETL Listed by the Manufacturer printed on the cable jacket and package, as well as Intertek (ETL) Verified to TIA-568 Category 6A and ISO/IEC 11801 Class EA requirements for channel, link and component performance to support IEEE 10GBASE-T (802.3an) networks

2.5.5.2.4 Maximum Cable Outer Diameter: 0.280 inch.

2.5.5.2.5 Documentation available from an independent third-party testing agency that verifies through random sampling that cable components perform at or above the levels contained on their product specifications, not simply at or above the standard.

2.5.5.2.6 Guaranteed cable balance improves overall performance and reduces emissions which results in error-free performance up to 10 Gigabit Ethernet with full duplex transmission.

2.5.5.2.7 Provided on spools to reduce risk of kinking cable upon deployment.

2.5.5.2.8 Cable shall be Plenum-rated (CMP) for any location where plenum cable is required.

2.5.5.2.9 Color: Gray, or as directed.

2.5.5.2.10 Be made by an ISO 9001 and 14001 Certified Manufacturer.

2.5.5.2.11 Guaranteed to meet or exceed Channel margin guarantees as stated above under System Performance

2.5.5.3 Category 6 (CAT6) Unshielded Twisted-Pair (UTP) cable

2.5.5.3.1 100-Ohm, 23 AWG, Category 6 4-pair balanced unshielded twisted pair solid annealed copper conductors.

2.5.5.3.2 Cable shall be characterized to 550 MHz and UL/ETL Listed by the Manufacturer printed on the cable jacket and package, as well as ETL Verified to TIA-568 Category 6 and ISO/IEC 11801 Class E.

2.5.5.3.3 Cable shall be Plenum-rated (CMP) for any location where plenum cable is required.

2.5.5.3.4 Color: Blue, or as directed.

2.5.5.3.5 Outer Diameter: 0.230 inch max.

2.5.5.3.6 Cable shall be guaranteed to exceed all TIA-568 link and channel performance requirements and be capable of supporting 1000Base-T (802.3ab) and ISO/IEC 11801 Class E applications for a total distance of 100 meters with equipment cords.

2.5.5.4 Category 6 (CAT6) Shielded Twisted-Pair (FTP) cable

2.5.5.4.1 100-Ohm, 23 AWG, Category 6 4-pair balanced unshielded twisted pair solid annealed copper conductors.

2.5.5.4.2 Cable shall be guaranteed to 500 MHz and UL/ETL Listed by the Manufacturer printed on the cable jacket and package, as well as ETL Verified to TIA-568 Category 6 and ISO/IEC 11801 Class E.

2.5.5.4.3 Cable shall be Plenum-rated (CMP) for any location where plenum cable is required.

2.5.5.4.4 Color: Gray, or as directed.

2.5.5.4.5 Outer Diameter: 0.285 inch max.

2.5.5.4.6 Cable shall be guaranteed to exceed all TIA-568 link and channel performance requirements and be capable of supporting 1000Base-T (802.3ab) and ISO/IEC 11801 Class E applications, and 10-gigabit Ethernet for a total distance of 100 meters with equipment cords.

2.5.5.5 All category cabling manufacturers must be able to provide documentation from an independent third-party testing agency that verifies through random sampling that cable components perform at or above the levels contained on their product specifications, not simply at or above the standard.

2.5.5.6 Cable may be CMR rated for areas not running through air handling spaces. CMP cable must be used if cable passes at any point through an air plenum or supply/return air handling space.

2.5.6 COPPER PATCH CORDS

2.5.6.1 Copper patch cords for CAT6A UTP and FTP cable systems shall exhibit the following characteristics:

2.5.6.1.1 Patch cord plug shall be a Slimline, integrated snag-less plug design made of industry standard, FCC compliant 94V-0 clear material without incorporating the use of a rubber molded overboot.

2.5.6.1.2 A narrow profile for less congestion in higher density applications and a clear plastic strain relief boot ensures long-term network performance

2.5.6.1.3 Independently tested and verified by Intertek (ETL) for CAT 6A component performance.

2.5.6.1.4 Cable construction provides excellent alien crosstalk suppression and EMI/RFI protection.

2.5.6.1.5 Constructed of shielded 26 AWG stranded conductor cable for maximum flexibility and outside diameter of 0.240 inch, for use in shielded and unshielded systems.

2.5.6.1.6 Patch cords in Plenum areas shall be Plenum-rated, and utilize solid conductor cable with Slimline snagless boot.

2.5.6.1.7 Complies with TIA 568-C.2-10 component requirements for connecting hardware from 1 MHz to 500 MHz, ISO 11801 Class E_A, IEEE 802.3an to support 10GBASE-T networks and cULus listed. Patch cords shall meet ANSI/TIA-1096-A requirements to include 50 micro inches of gold plating.

2.5.6.1.8 The patch cord jacket shall meet or exceed UL 444 CM rating and be RoHS compliant.

2.5.6.1.9 The patch cords shall be available in standard 3, 5, 7, 10, 15, and 20 foot lengths. Custom lengths from 1 foot and above shall also be available through a made to order program.

2.5.6.1.10 Typical CAT6A color: White (UTP), Gray (FTP).

2.5.6.2 Standard-diameter copper patch cords for CAT6 UTP user locations shall exhibit the following characteristics:

2.5.6.2.1 26-gauge, unshielded, twisted pair, stranded conductor construction with a standard 8-position modular plug on both ends.

2.5.6.2.2 Plug contacts shall be plated with minimum of 50 micro-inches of gold

2.5.6.2.3 Slimline, integrated snag-less molded plug design with integrated strain relief, without incorporating the use of any secondary or 2-piece rubber over-boot.

2.5.6.2.4 Maximum Outer Diameter of 0.24 inch

2.5.6.2.5 Power over Ethernet (PoE and PoE+) compatible

2.5.6.2.6 Support 1 Gigabit applications over 90-meter permanent links with up to 10 meters of cordage

2.5.6.2.7 Meets all applicable standards and listings: ANSI/TIA-1096-A (formerly FCC Part 68), RoHS compliant, IEEE 802.3, PoE: IEEE 802.3at – 2012

2.5.6.2.8 The patch cord shall be available in 7 standard colors. Typical CAT6 UTP color: Blue

2.5.6.3 Standard-diameter copper patch cords for CAT6 FTP user locations shall exhibit the following characteristics:

2.5.6.3.1 26-gauge, unshielded, twisted pair, stranded conductor construction with a standard 8-position modular plug on both ends.

2.5.6.3.2 Plug contacts shall be plated with minimum of 50 micro-inches (µm) of gold

2.5.6.3.3 Slimline, integrated snag-less molded plug design with integrated strain relief, without incorporating the use of any secondary or 2-piece rubber over-boot.

2.5.6.3.4 Maximum Outer Diameter of 0.24 inch

2.5.6.3.5 Power over Ethernet (PoE and PoE+) compatible

2.5.6.3.6 Support 1 Gigabit applications over 90-meter permanent links with up to 10 meters of cordage

2.5.6.3.7 Meets all applicable standards and listings: ANSI/TIA-1096-A (formerly FCC Part 68), RoHS compliant, IEEE 802.3, PoE: IEEE 802.3at – 2012

2.5.6.3.8 CAT6 FTP color: Gray

2.5.6.4 High-flex copper patch cords for CAT6 UTP cable systems used inside Telecom Enclosures, Rooms and racks shall exhibit the following characteristics:

2.5.6.4.1 28-gauge, unshielded, twisted pair, stranded conductor construction with a standard 8-position modular plug on both ends.

2.5.6.4.2 Plug contacts shall be plated with minimum of 50 micro-inches (µm) of gold

2.5.6.4.3 Slimline, integrated snag-less molded plug design with integrated strain relief, without incorporating the use of a secondary or 2-piece boot.

2.5.6.4.4 Ultra-narrow diameter, highly flexible cord for less congestion in higher density applications

2.5.6.4.5 Maximum Outer Diameter of 0.15 inch, minimum bend radius 0.60 inch

2.5.6.4.6 Power over Ethernet (PoE and PoE+) compatible

2.5.6.4.7 Support 1 Gigabit applications over 90-meter permanent links with up to 6 meters of cordage

2.5.6.4.8 Meets all applicable standards and listings: ANSI/TIA-1096-A (formerly FCC Part 68), RoHS compliant, IEEE 802.3, PoE: IEEE 802.3at – 2012

2.5.6.4.9 Color: Blue

2.5.6.4.10 To be used at patch panel end of any CAT6 UTP permanent link.

2.5.6.5 Provide and install only factory-assembled patch cords of the same or better Category rating of the permanent link cabling system, in quantities as described in Part 3 of this Specification.

2.6 BACKBONE CABLING SYSTEMS

2.6.1 GENERAL

2.6.1.1 Copper cables allowed for use in the backbone include: 4-pair 100-ohm unshielded twisted-pair 100 percent annealed-copper solid-conductor cables, 100-ohm UTP multi-pair copper cables. Fiber optic backbone cables shall be 50/125µm Laser-Optimized Multimode Fiber and 8.3µm low-water peak single mode optical fiber cables compliant with ITU-T G.6520 (or OS2). The cable shall support voice, data, and multimedia applications. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation.

2.6.2 VOICE COPPER BACKBONE CABLE

2.6.2.1 Power-Sum Multi-Pair Category 3 cable, 24 AWG solid-copper conductors in 25-pair binder groups to support 10BASE-T, 100BASE-T and Analog Voice communications at 16MHz.

2.6.2.2 Copper backbone cables shall be terminated onto a rack-mounted modular RJ45-style patch panel.

2.6.2.3 Terminate Category 3 cables onto Category 5e patch panels at 1 pair per port, with the last of the 25-pair cable coiled (full length) for future use. Use black outlet colors on patch panel for Category 3 connectivity.

2.6.3 OPTICAL FIBER CABLE

2.6.3.1 SINGLEMODE Optical Fiber

2.6.3.1.1 Optical fiber cables run shall be low-water-peak Singlemode (OS2), and meet all of the requirements delineated within the specifications of ANSI/TIA-568 and ANSI/TIA- 492 .AAAC-B.

2.6.3.1.2 Armored fiber optic cables will utilize an interlocking armor outer cover around an integrated tight-buffer (indoor only) or Loose-Tube (indoor/outdoor) cable construction. Plenum armored fiber may be run in open ceilings without conduit or innerduct.

2.6.3.1.3 Indoor fiber optic cable shall be minimum 12 strands, tight buffered, and individual fiber strands shall be 900 micron jacketed.

2.6.3.1.4 Outdoor or indoor/outdoor fiber optic cable used for building-to-building interconnections shall be minimum 24 strands, loose tube construction with 250 micron unjacketed fiber strands in a 12-strand buffer tube.

2.6.3.1.5 Cables are typically OFNR rated for in-conduit applications, but must always be constructed of materials and rated appropriate for the environment in which it is installed (Indoor, Indoor/Outdoor, Outside Plant (OSP), OFNP or OFNR, OFCP or OFCR). In-slab conduits are considered a "wet environment" and require OSP or Indoor/Outdoor rating. Cables running at least a portion of the length through an open-air plenum or air handling space must be OFNP or OFCP (plenum) rated. Contractor is solely responsible for installation of the correctly-rated cable in the appropriate environment, as required by the AHJ or local ordinance

2.6.3.1.6 Loose tube fibers shall utilize a fan-out kit to fit 250 micron fibers into a 900 micron protective sheath when terminating. Loose Tube cables are generally expected for outdoor environments.

2.6.3.2 MULTIMODE FIBER OPTIC CABLE - FIELD TERMINATED

2.6.3.2.1 Multimode fiber optical fiber cables shall meet all of the requirements delineated within the specifications of ANSI/TIA-568 and ANSI/TIA-492 .CAAB (OM4). Must be a minimum of 12 strands, typically 24 strands, of Laser-Optimized 50 micron optical fiber. Cable jacketing must be appropriate for the

environment in which it is installed (Indoor, Indoor/Outdoor, Outside Plant, OFNP or OFNR).

2.6.3.2.2 Fiber optic cables will utilize an interlocking armor outer cover around an integrated Tight-Buffered (indoor only) cable construction and fiber strands with a 900 micron protective sheath.

2.6.3.2.3 See plans and scope of work for total strand count between locations.

2.6.3.3 MULTIMODE FIBER OPTIC CABLES - FACTORY PRETERMINATED

2.6.3.3.1 Optical fiber cables shall meet all of the requirements delineated within the specifications of ANSI/TIA-568. Cables must be a minimum of 24 strands of 50/125µm (micron) OM4 Laser-Optimized Multi-Mode Fiber (LOMMF) for backbone cabling. Cables must be appropriate for the environment in which it is installed (Indoor, Indoor/Outdoor, OFNP or OFNR) but are not suitable for Outside Plant (aerial or underground). Backbone cables may be used rack-to-rack, MDF-to-IDF, or similar intrabuilding applications.

2.6.3.3.2 Pre-terminated backbone cables will utilize the MTP® connector, employing a multi strand ferrule capable of supporting 1G, 10G, 40G or 100G Ethernet and beyond. The MTP® connector is not a field-installable connector, and must be factory polished and tested to ensure precise fiber alignment and finish.

2.6.3.3.3 All optical fiber backbone cables (trunks) shall be factory terminated, dry loose tube, armored jacket, Laser Optimized 50 micron OM4 for plenum-rated applications. All trunks shall be labeled on both ends with machine labeling and bar coded with unique numbers. Labels shall be highly visible with white background and black lettering, and shall list origination and destination on both ends before break of individual legs. All Fiber Trunk assemblies shall possess the following characteristics at a minimum:

2.6.3.3.3.1 Meet or exceed TIA 568 for OM4 performance at 550 meters for 10 Gigabit and 150 meters for 40 Gigabit or 100 Gigabit transmissions.

2.6.3.3.3.2 Optical fiber jackets shall be durable jacketed construction utilizing loose tube design, aramid yarn, and fiberglass strength members for protection.

2.6.3.3.3.3 Optical fiber cable trunks shall have a minimum breakout of 3 feet. All fiber trunks shall utilize a heat shrink at the ends of all breakouts to create a smooth breakout of the fiber subunit legs.

2.6.3.3.3.4 Optical fiber subunits shall utilize a round construction. Ribbon construction is not acceptable.

2.6.3.3.3.5 All fiber connectors must meet TIA 604.X for compatibility.

2.6.3.3.3.6 All Multimode optical fiber subunits of 24 strands shall utilize the 24-strand MTP connector. Optical Fiber subunits of 12 strands shall utilize a 12-strand MTP connector. No optical fiber subunits shall be smaller than 12 strands except for fiber optic jumpers used within the same racks.

2.6.3.3.3.7 Multimode fiber optic trunks shall utilize female MTP connectors. 24-strand MTP connectors shall have a Red boot, and 12-strand MTP shall use a Black or Aqua boot.

2.6.3.3.3.8 Singlemode MTP connectors shall be 12-strand, Angle-Polish, and shall have a Green boot.

2.6.3.3.3.9 Manufacturer shall provide MTP® brand connectors for specific superior performance characteristics. Generic MPO-style connectors are not acceptable quality. Use of only ferrules or other essential components will not be acceptable, but only the complete MTP system of components used at each connector assembly.

2.6.3.3.3.10 All MTP connectors shall be laser cleaved to increase hardness of tip and precision of end product.

2.6.3.3.3.11 All Multimode Fiber Optic Trunks shall utilize Method B Polarity. Singlemode fiber optic trunks shall utilize Method C.

2.6.3.3.3.12 All optical fiber cabling trunks shall have a unique identifying label with a bar code for quick identification. The label shall state Manufacturer, trunk length and serial number. Custom labeling shall be available from the manufacturer as an option to aid in deployment during construction.

2.6.3.3.3.13 A pulling eye shall be installed on one end of all trunks to help facilitate installation.

2.6.3.3.3.14 All optical fiber trunks shall be shipped to project site with a number on the box that will correspond to the layout of the facility for easy identification by the Vendor. All fiber trunks shall include a printed summary test file of all fiber strands inside the box for the Vendor. Additionally, the Manufacturer shall hold all full test data until the project is complete and provide them to Owner along with the applications assurance warranty after the project is completed

2.6.3.3.3.15 Installation contractor will re-test all fiber trunks upon completed installation and provide test results to Manufacturer for completion of full product warranty requirements.

2.6.3.3.3.16 The Contractor shall be responsible for the correct fiber trunk lengths, configuration, and ordering. Fiber Trunk part numbers shall be generated from Leviton.com Online Configurator and must be verified with the Manufacturer prior to ordering.

2.6.4 RACK-MOUNT FIBER OPTIC ENCLOSURES, PANELS AND TRAYS

2.6.4.1 All Fiber enclosures shall provide cross connect, inter connect, and splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

2.6.4.2 Fiber Adapter panel openings shall accept Fiber Adapter Plates (bulkheads), Splice Modules, and plug-n-play MTP modules/cassettes or any combination thereof.

2.6.4.3 1RU, 2RU and 4RU enclosures shall hold up to 3, 6 or 12 adapter plates or cassettes, respectively.

2.6.4.4 All Fiber enclosures, panels and trays (units) shall provide cross-connect, inter-connect, and splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

2.6.4.5 Fiber enclosures shall exhibit the following characteristics:

2.6.4.5.1 Fiber enclosure shall be available in 1RU, 2RU or 4RU versions to accommodate fiber adapter plates, MTP Modules, and/or termination and splicing of fiber as needed

2.6.4.5.2 Enclosure shall inherently accept a 1-panel integrated splice cassette.

2.6.4.5.3 Enclosures shall have a sliding tray which can be removed completely from enclosure (from front or rear) to facilitate field terminations and splicing. Sliding tray glides forward and backward providing accessibility to front and rear bulkhead after installation.

2.6.4.5.4 17 inch depth for high density fiber termination and/or splicing.

2.6.4.5.5 Removable transparent hinged doors and slide away covers allow easy access during install and visibility of interior after installation.

2.6.4.5.6 Patch cord bend radius guides minimize macro bending.

2.6.4.5.7 Stackable and adjustable fiber rings simplify cable routing and organization

2.6.4.5.8 Fiber Jumper saddles pivot for improved patch cord routing and organization

2.6.4.5.9 Removable rubber grommets protect cable and minimize dust build-up

2.6.4.5.10 Multiple mounting bracket positions for 19 inch or 23 inch rack and cabinet installation (23 inch 1RU mounting bracket sold separately)

2.6.4.5.11 Constructed of durable polycarbonate plastic and 16-gauge steel, powder-coated black

2.6.4.5.12 Door lock option available on front, rear, or both doors

2.6.4.5.13 Fiber cable management shall allow for routing, storage, and protection of patch cords, tight-buffer fiber, and backbone cables.

2.6.4.5.14 Enclosure shall be available either empty or in custom pre-loaded configurations.

2.6.5 WALL-MOUNT FIBER OPTIC ENCLOSURES, PANELS AND TRAYS

2.6.5.1 All Fiber enclosures shall provide cross connect, inter connect, and splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

2.6.5.2 Fiber Adapter panel openings shall accept Fiber Adapter Plates (bulkheads), Splice Modules, and plug-n-play MTP modules/cassettes or any combination thereof.

2.6.5.3 Mini, Small, Medium and Large wall-mount enclosures shall hold up to 1, 2, 4 or 12 adapter plates or cassettes, respectively.

2.6.5.4 All Fiber enclosures, panels and trays (units) shall provide cross-connect, inter-connect, and splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

2.6.5.5 Small, Medium and Large Wall-Mount Fiber Enclosures shall exhibit the following characteristics:

2.6.5.5.1 Fiber enclosure shall be available in 12 inch x14 inch Small (2.16 inch low profile depth) and Medium (3.86 inch depth) sizes, and 16.5 inch x 17.22 inch (6.18 inch deep). Large versions to accommodate fiber adapter plates, MTP Modules, and/or termination and splicing of fiber as needed.

2.6.5.5.2 Shall have dual hinged doors to accommodate building-side (service side) and patching-side (customer-side) cables separately.

2.6.5.5.3 Enclosures can be oriented for left- or right-side patching to provide added flexibility.

2.6.5.5.4 Adapter bulk head shall accept Opt-X SDX Precision-Molded Adapter Plates, SDX Splice Modules, and SDX MTP Cassettes in LC, SC, ST, and MTP connectivity. Fiber cable management for routing, storage, and protection shall accept tight-buffered fiber and backbone cables.

2.6.5.5.5 Enclosures shall be constructed of 16-gauge steel with a powder-coated black finish and be mountable on a wall. An optional key/lock kit shall be available to lock the service side door or both service and customer side.

2.6.5.5.6 Removable cable entry/exit grommets allow for pre-terminated fiber trunk install, cable protection, and minimizes dust build up

2.6.5.5.7 Ground lug provided for added cable strain relief protection and grounding of armored cable

2.6.5.5.8 Optional features to include:

2.6.5.5.8.1 Cable strain-relief mounting kit (installed on service side) protects incoming fiber cable

2.6.5.5.8.2 Key/lock kit secures service side door or service and customer side doors

2.6.5.5.8.3 HDX-to-SDX conversion adapter bracket accepts HDX Adapter Plates and HDX Cassettes

2.6.5.5.8.4 QuickPort® Adapter Plate accepts all QuickPort modules for copper or fiber connectors

2.6.5.5.8.5 Accessory kit consisting of VELCRO brand cable ties, mounting screws, cable managers, port ID labels, blank plates and CAM lock (for splice-only enclosure)

2.6.5.6 Mini Wall-mounted Fiber Enclosure shall exhibit the following characteristics:

2.6.5.6.1 Fiber enclosure shall be available in 6.0 inch x 6.53 inch x 1.75 inch size to accommodate fiber adapter plates, MTP Modules, and/or termination and splicing of fiber as needed.

2.6.5.6.2 Enclosure can be oriented for left- or right-side patching to provide added flexibility.

2.6.5.6.3 Adapter bulk head shall accept Opt-X SDX Precision-Molded and Metal Adapter Plates, SDX Splice Modules, and SDX MTP Cassettes in LC, SC, ST, and MTP connectivity.

2.6.5.6.4 Fiber cable management for routing, storage, and protection shall accept tight- buffered fiber and backbone cables.

2.6.5.6.5 Enclosures shall be constructed of 16-gauge steel with a powder-coated black finish and be mountable on a wall or in a 0RU configuration within a rack or cabinet.

2.6.5.6.6 Multiple application usage, including wall mount, 0RU in rack/cabinet, ladder rack, workstation, cubicle, and within an enclosure (using adhesive-based tapes or magnets)

2.6.5.6.7 Removable cable entry/exit grommets allow for pre-terminated fiber trunk install, cable protection, and minimizes dust build up

2.6.5.6.8 Optional features to include

2.6.5.6.8.1 0RU mounting bracket and mounting magnets (Recommend use of 3M 5952 VHB™, double-sided tape in conjunction with magnets for 0RU application)

2.6.5.6.8.2 Accessory kit consisting of cable VELCRO® Brand ties, mounting screws, port ID label, and patch cord cable managers

2.6.5.6.8.3 Key/lock kit secures door for added security

2.6.5.6.8.4 HDX-to-SDX conversion adapter bracket accepts HDX Adapter Plates and HDX Cassettes

2.6.5.6.8.5 QuickPort® Adapter Plate accepts all QuickPort modules for copper or fiber connectors

2.6.6 FIBER TERMINATION PRODUCTS

2.6.6.1 FIBER OPTIC SPLICE CASSETTES AND MODULES

2.6.6.1.1 Use of fusion splice cassette assemblies shall be the standard means of splicing fiber optic cables at the enclosure.

2.6.6.1.2 Fiber Optic Splices shall be done using fusion splice equipment. Mechanical splices are not permitted.

2.6.6.1.3 Splice cassettes shall be offered in 12- or 24-fiber LC configurations in OS2 fiber type. Construction of module shall be of 14-gauge aluminum for robustness and light weight.

2.6.6.1.4 Splice cassettes shall be pre-loaded and routed with respective 3-meter, color-coded pigtail assembly.

2.6.6.1.5 Individual OS2 pigtails shall have maximum insertion loss of 0.3 dB. Return Loss shall be greater than 55 dB.

2.6.6.1.6 Individual compartments shall provide slack storage and bend radius protection for incoming backbone fibers, 900 µm tight-buffer fibers, and fusion-spliced fibers.

2.6.6.1.7 Incoming 250 µm backbone fibers shall be protected by a braided mesh sleeve. Heat shrink style splice sleeves, braided mesh sleeve, and tie wraps shall be included with module.

2.6.6.2 FIBER CONNECTORS

2.6.6.2.1 Pre-polished fiber optic connectors shall be the primary means of field-terminating individual fiber strands at the enclosure or faceplate location.

2.6.6.2.2 Shall meet or exceed the requirements described in TIA-568 and ANSI/TIA-604-10 (LC) Connector Intermateablity Standards

2.6.6.2.3 Shall be pre-polished and field installable to eliminate the need for hand polishing, bonding, or epoxy in the field.

2.6.6.2.4 Shall utilize a precision zirconia ceramic ferrule, and be re-terminable up to 3 times during testing without loss of performance.

2.6.6.2.5 Shall require the use of a cleaver with a guaranteed maximum cleaving angle of 2 degrees for multimode and 1 degree for singlemode fibers.

2.6.6.2.6 Shall be provided in LC, single-mode or multimode (laser optimized) configurations, terminated on 250 or 900 µm buffered fiber and/or 2mm or 3 mm jacketed fiber.

2.6.6.2.7 Maximum connector insertion loss shall be no greater than 0.5 dB, with an average of 0.1 dB (MM) or 0.2dB (SM). Typical connector return loss shall be 35 dB (multimode) and 56 dB (single mode). All versions shall allow continuity to be verified by use of a visual fault locator (VFL).

2.6.6.3 FIBER ADAPTER PLATES

2.6.6.3.1 The fiber adapter plate shall be modular and functional for use in either a wall-mount or rack-mount enclosure. The adapter plate shall be provided in LC styles, in 12- or 24-fiber configurations. 12-fiber adapter plates are used to terminate 12-fiber cables, and 24-fiber adapter plates are used to terminate 24-fiber (or greater) cables. Do not utilize adapter plates with unused ports at the rear.

2.6.6.3.2 The adapter plate shall be compliant to TIA-568 (for performance) and respective TIA-604-X (for intermateability) standards. Adapter plates shall use zirconia ceramic sleeves and be offered in standard fiber type colors pursuant to TIA-568 standards.

2.6.6.3.3 LC adapter plates shall be precision-molded in the USA and integrated to eliminate "rattle" and loose fit. All ferrules shall be zirconia-ceramic. Adapter plates shall be offered in standard fiber type colors. Singlemode color shall be BLUE.

2.6.6.4 MTP® MODULES FOR PRE-TERMINATED CABLES

2.6.6.4.1 24-strand Multi-Mode Fiber optic MTP-MTP configured trunks which terminate in LC connectors will land on a 24-strand (12 LC Duplex Port) MTP-LC Cassette module and will utilize a 24-strand MTP connector at each end of the trunk. 12-strand Multi-Mode Fiber optic MTP-MTP configured trunks which terminate in LC connectors will land on a 12-strand (6 LC Duplex Port) MTP-LC Cassette module using 12-strand MTP connectors.

2.6.6.4.2 24-strand Multi-Mode Fiber optic MTP-MTP configured trunks which terminate in MTP 40G connectors will land on an MTP - MTP Cassette module with (3) 8-strand MTP connectors on the front. Trunks utilizing 2 or more 24-strand MTP connectors may land on a MTP module displaying (2) 24-strand MTP connectors in the rear, and (6) 8-strand (40G) MTP connectors in the front. Multiple modules may be required if trunk cables are configured with greater strand counts or connectors.

2.6.6.4.3 12- or 24-strand Singlemode Fiber optic MTP-LC cassettes shall be configured with 12-strand MTP connections in rear.

2.6.6.4.4 The MTP modules shall meet the following requirements:

2.6.6.4.4.1 Insertable directly into fiber enclosure panel openings with a push-pin/grommet latch.

2.6.6.4.4.2 Rated for Laser Optimized Multi-mode OM4 optical fiber or OS2 Singlemode.

2.6.6.4.4.3 Multimode shall utilize Method B Polarity and Singlemode uses Method C.

2.6.6.4.4.4 Multimode shall require one Core module at one end of a fiber trunk segment, and one Edge module at the second end to maintain correct polarity across the system. Core modules will be used at the MDF and Edge modules at the IDF ends of the cable for consistency of design.

2.6.6.4.4.5 Singlemode modules shall utilize Method C at both ends of the fiber trunk cable.

2.6.6.4.4.6 40G MTP connector housings at front of module shall be Black.

2.6.6.5 FIBER JUMPERS AND ARRAY CORDS

2.6.6.5.1 Fiber optic LC-LC patch cords, or jumpers, will make LC connections from the rack termination points to the equipment. The jumpers will meet the following requirements:

2.6.6.5.1.1 Factory-manufactured using Singlemode OS2 optical fiber. Field terminations on fiber jumpers are not acceptable.

2.6.6.5.1.2 Shall utilize A-B polarity.

2.6.6.5.1.3 Shall exhibit <0.3 dB insertion loss and -25 dB return loss.

2.6.6.5.1.4 Shall be available in standard lengths of 1, 2, 3, 5 and 10 meters and custom- orderable up to any length of feet or meters

2.6.6.5.1.5 Provide factory assembled patch cords meeting or exceeding all criteria specified in the horizontal cabling standard

2.6.6.5.1.6 Verify lengths, quantities and configuration with Owner prior to delivery.

2.6.6.5.2 Fiber-Optic MTP-MTP "array cords" shall utilize 8-strand MTP (female) to 8-strand MTP (male) connectors in a 3mm breakout jacket. The array cords will meet the following requirements:

2.6.6.5.2.1 Array cords shall meet an optical insertion loss not to exceed 0.35 dB per mated connector pair.

2.6.6.5.2.2 Array cords shall be available in 1-, 2-, 3-, 5-, and 10-meter lengths.

2.6.6.5.2.3 Array cords shall be compliant with TIA-568-C .3 and IEEE 802.3ba and available in UL Riser or Plenum rated cables (Riser is acceptable for in-rack patching)

2.6.6.5.2.4 Meets TIA-568-C.3 and IEEE 802.3ba standards (40/100GbE), and adheres to TIA-942 data center design guidelines.

2.6.6.5.2.5 Boot color for 8-strand MTP array cords shall be Dark Gray.

2.6.6.5.2.6 MTP shall be pinned on one end, unpinned on the other, and utilize Method B polarity.

2.7 AUDIO VISUAL SYSTEMS

2.7.1 HDBASE-T DEVICES

2.7.1.1 GENERAL

2.7.1.1.1 Units shall be certified by the HDBaseT Alliance to ensure compatibility and performance.

2.7.1.1.2 Class 2 Extenders shall be Certified to support plug-and-play installation including HD video, multi-channel audio, bi-directional power, bi-directional IR, and RS-232 control.

2.7.1.1.3 Class 1 Extenders shall include support for all Class 1 devices with the addition of HDBaseT 5Play™ 100Mb Ethernet, up to 100 meters.

2.7.1.1.4 Extenders shall be compatible with and support key features of HDMI 1.4 including EPG, CEC, EDID, and HDCP.

2.7.1.1.5 Extenders shall include bi-directional PoH (power over HDBT), IR, RS-232.

2.7.1.1.6 Transmitter and receiver shall include power, operating status, link and HDCP status indicator LEDs to aid in setup

2.7.1.1.7 Transmitter and receiver shall be FCC Part 15; subpart B, Class B compliant

2.7.1.1.8 Locking feature for HDMI and power input connections shall be included. Extender transmitter and receiver shall have a metal enclosure and include mounting brackets.

2.7.1.1.9 Extender sets shall also include RS-232 interface cables and DC power adapter with a set of interchangeable international input plugs.

2.7.1.1.10 Extender sets shall support IR emitter and target kit for bi-directional control

2.7.1.2 HDBASE-T/HDMI Extender Transmitter & Receiver- 100m Version

2.7.1.2.1 100m HDMI extender shall deliver uncompressed HD video, 3D, and 2K x 4K over a single category cable with multi-channel audio supporting all standard formats including Dolby Digital, DTS, Dolby TrueHD, and DTS HD-Master Audio.

2.7.1.2.2 Resolution capability shall be 1080p 36 bit deep color at 60Hz with VESA resolutions up to 1920 x 1200 at 60Hz up to 100m (328 ft) and 4K ultra high definition up to 2160p 24 bit true color at 30Hz with 4K chroma subsampling color palette 4:2:2 up to 60m (197 ft).

2.7.1.2.3 Extenders shall include Ethernet channel capability with dual 100Mbps Ethernet ports.

2.7.1.3 HDBASE-T/HDMI Extender Transmitter & Receiver- 70m Version

2.7.1.3.1 70m HDMI extender shall deliver uncompressed HD video, 3D, and 2K x 4K over a single category cable with multi-channel audio supporting all standard formats including Dolby Digital, DTS, Dolby TrueHD, and DTS HD-Master Audio.

2.7.1.3.2 Resolution capability shall be 1080p 36 bit deep color at 60Hz with VESA resolutions up to 1920 x 1200 at 60Hz up to 70m (230 ft) and 4K ultra high definition up to 2160p 24 bit true color at 30Hz with 4K chroma subsampling color palette 4:2:2 up to 60m (197 ft).

2.7.1.3.3 The receiver shall be available separately for use with other HDBaseT certified devices

2.7.1.4 HDMI/VGA Autoswitching Extender Wallplate

2.7.1.4.1 Shall function as a user input device for source *A/V* equipment with HDMI or VGA/Audio outputs and forward those signals to appropriate display device(s) across an HDBase-T link.

2.7.1.4.2 Inputs shall include two (2) HDMI, one (1) VGA, and one (1) Analog Audio (for VGA) connections, output shall be one (1) RJ-45 (HDBaseT).

2.7.1.4.3 Inputs shall be automatically switched based on input presence sensing (or manually selected) to permit seamless transfer from one source to the next.

2.7.1.4.4 Shall include a "SOURCE/AUTO" button to select manual or auto source selection, and signal lights to indicate selected source and source activity.

2.7.1.4.5 Shall have a connection to allow external control via separate optional remote wallplate controller.

2.7.1.4.6 Shall be HDBaseT Alliance certified for compatibility with other compliant HDBase-T extension devices.

2.7.1.4.7 Shall be housed in a dual-gang Decora® form factor with matte anodized aluminum finish.

2.7.1.4.8 Shall deliver full uncompressed HD video in 3D, 2K, and 4K (VESA resolutions up to 1920 X 1200 at 60Hz, and HDTV resolutions up to 2160p) over single category cable up to 70 meters (230 feet).

2.7.1.4.9 Shall also support VGA resolution to 1920 X 1200.

2.7.1.4.10 Shall include a built-in scaling function to automatically match signals to 1080p display resolution.

2.7.1.4.11 Shall include Power over HDBaseT (PoH) capability, allowing powering from the receiver at the display end.

2.7.1.4.12 HDMI and VGA inputs shall include connector locking features.

2.7.1.4.13 Shall include an IR (Infrared) "target" and support IR repeating through the HDBaseT link to receiver at display end.

2.7.1.4.14 Shall be a maximum of 1.5 inch in depth to allow mounting in standard 4-inch or 4.675- inch square electrical box.

2.7.1.5 Remote Switching Multibutton Control Wallplate

2.7.1.5.1 Shall integrate with the Autoswitching Extender Wallplate to add an additional remote control location.

2.7.1.5.2 Shall have eight (8) configurable buttons and fit in a dual-gang form factor.

2.7.1.5.3 Shall be all-metal construction and have a matte anodized aluminum finish.

2.7.1.5.4 Buttons shall be pre-configured for power on/off, volume up/down, HDMI 1, HDMI 2, VGA, and lock.

2.7.1.5.5 Setup shall be via IR learning and include a copy/paste function to expedite setup of multiple rooms for larger projects.

2.7.1.5.6 Installation shall not require additional computer hardware, Internet access, or software.

2.7.1.5.7 Shall include a key lock function to reduce inadvertent operation in the field.

2.7.1.5.8 Volume buttons shall operate by both single press and press/hold.

2.7.2 STANDARD AV EXTENSION DEVICES

2.7.2.1 HDMI Extender Transmitter & Receiver- 40 meter version

2.7.2.1.1 HDMI transmitter and receiver shall extend HDMI signal up to 40 meters over dual category-rated cables.

2.7.2.1.2 Transmitter and Receiver shall support VESA resolutions up to 1920 X 1200 @ 60Hz, and HDTV resolutions up to 1080p over two category cables up to 40m (131 ft) and 720p/1080i (HDTV) up to 60m (197 ft).

2.7.2.1.3 Transmitter and Receiver shall support Dolby True HD and DTS HD Master Audio, and be EDID, HDCP, and DDC compatible.

2.7.2.1.4 Transmitter and Receiver shall include 8-position equalization adjustment for optimizing display quality over varying cable lengths

2.7.2.1.5 Transmitter and Receiver shall include Power and On-Line LEDs to aid in setup

2.7.2.1.6 Transmitter and Receiver shall include locking feature for HDMI connectors

2.7.2.1.7 Separate TMDS and DDC ports shall be included to use a single category cable where HDCP and EDID bypass features are not required

2.7.2.1.8 Transmitter and receiver shall be FCC Part 15; subpart B, Class A compliant

2.7.2.1.9 AC power adapters shall be included for both Tx and Rx units.

2.7.2.2 VGA Extender Transmitter and Receiver

2.7.2.2.1 VGA Extender shall deliver screen resolutions of 1920 X 1200 @ 60Hz up to 30m (98 ft) and 1600 X 1200 up to 100m (328ft) over one Category cable.

2.7.2.2.2 VGA Extender shall support mono audio transmission.

2.7.2.2.3 VGA Extender shall provide adjustable gain for optimizing display quality over varying cable lengths.

2.7.2.2.4 VGA Extender shall include power, and link LED indicators.

2.7.2.2.5 VGA Extender shall support hot-plugging of source devices for instant video output.

2.7.2.2.6 VGA Extender shall support mono audio transmission via 3.5 mm Audio input and output ports on devices.

2.7.2.2.7 External power shall be required only at receiver

2.7.2.2.8 Transmitter and receiver shall be FCC Part 15; subpart B, Class B compliant

2.7.2.2.9 USB to power adapter cable shall be included for powering receiver from display USB port

2.7.2.2.10 VGA cable shall be included for connection of receiver to display

2.7.2.2.11 3.5mm audio cable shall be included for connection of source device audio output to transmitter

2.7.2.2.12 Transmitter shall include thumbscrews to connect directly to source without need for VGA cable. Extender transmitter and receiver shall have a metal enclosure and include mounting brackets for surface mounting.

2.7.2.2.13 AC power adapters shall be included for both Tx and Rx units.

2.7.2.3 USB 1.1 Extender Transmitter and Receiver

2.7.2.3.1 USB Extender shall extend USB 1.1 signals from computer to device or hub up to 50 meters (164 ft) over a single category-rated cable.

2.7.2.3.2 USB Extender shall comply with USB 1.1 specification.

2.7.2.3.3 USB Extender shall support high-speed 12Mb/s and low-speed 1.5Mbp/s protocols.

2.7.2.3.4 No external power shall be required.

2.7.2.3.5 Transmitter shall include integral 0.3m (1ft) cable for flexible connection to computer port.

2.7.2.3.6 Transmitter and Receiver interface housing shall be made of high impact plastic and be no larger than 2.56 inch L x 1.22 inch W x 0.85 inch H.

2.7.2.3.7 Transmitter and receiver shall be FCC Part 15; subpart B, Class B compliant

2.7.3 AUDIO AMPLIFICATION

2.7.3.1 Stereo Mixing Audio Amplifier

2.7.3.1.1 Mixing Audio Amplifier shall include two stereo audio inputs, and one balanced microphone input.

2.7.3.1.2 The amplifier shall offer three output modes: 2 X 20W stereo, 1 X 40W bridge mono, and 2 X 20W dual mono.

2.7.3.1.3 Three switchable inputs: two stereo audio and one mic

2.7.3.1.4 The amplifier shall include a Mic mixer function with independent control; Mic input shall support 48 V phantom power.

2.7.3.1.5 The amplifier shall include a line-audio output jack with controllable volume, volume, bass, treble, and mute controls and auto output mute on no input.

2.7.3.1.6 The amplifier shall have a 20Hz - 20KHz frequency response range

2.7.3.1.7 The amplifier shall include LED indicators for power and control function feedback.

2.7.3.1.8 The amplifier shall be controllable via front panel controls and through infrared remote and/or RS232 interfaces.

2.7.3.1.9 The amplifier shall include a locking power supply connector

2.7.3.1.10 The amplifier shall be surface mountable with dimensions not to exceed 3.43 inch L x 4.84 inch W x 1.49 inch H.

2.7.3.2 70V Mixing Audio Amplifier

2.7.3.2.1 Mixing Audio Amplifier shall include two stereo audio summed inputs (RCA and 3.5mm), one digital audio fiber input, and balanced microphone input.

2.7.3.2.2 Selectable independently controlled mic input shall have a mixer function, priority muting, and support 48V phantom power

2.7.3.2.3 The Amplifier shall support 40W mono output at constant 70V or 100V.

2.7.3.2.4 The Amplifier shall be controllable via front panel controls with LED indicators and through infrared and RS232 interfaces with 16 ID code selections.

2.7.3.2.5 The amplifier shall be fanless and shall include 24V power supply with locking connector and mounting brackets.

2.7.3.2.6 The Amplifier shall include volume, bass, treble, and mute controls

2.7.3.2.7 The amplifier shall have a frequency response range of 20Hz to 20KHz

2.7.4 CABLING

2.7.4.1 HDBaseT Cables

2.7.4.1.1 Cabling channels supporting HDBaseT signals shall be TIA/ISO Category 6A/Class EA compliant, utilizing Shielded or Noise Cancelling Isolation Wrap (segmented shield) cable and appropriate termination components.

2.7.4.1.2 The cabling channel shall comply with Power over HDBaseT™(POH) applications up to 100 watts.

2.7.4.1.3 Utilize CAT6A UTP cable as described above in Horizontal Cabling section for HDBaseT and other AV connections in this Section.

2.7.4.2 HDBaseT Connectors

2.7.4.2.1 Modular Connectors shall be 8P8C (RJ45) CAT6A UTP jacks as described above in Horizontal Cabling section.

2.7.4.2.2 Connectors shall be die cast, Quickport (Keystone) footprint, and fit in any faceplate, biscuit block or ceiling/box mount provided for in this Specification.

2.7.4.2.3 Connector module shall be UL 2043 Plenum Certified. Wiring shall be universal and will accommodate both T568A and T568B pair/pin assignments.

2.7.4.2.4 Connector Module shall be supplied with interchangeable icons (voice, data, A/V, and blank, color coded to match the connector face) for easy identification and tracking of data, voice, or other functions and shall be available in 13 different colors.

2.7.4.3 HDMI Connectors

2.7.4.3.1 HDMI pass-through connectors landing in faceplates shall fit surrounding connectors in the same Quickport keystone-style device plate.

2.7.4.4 HDBaseT Cords

2.7.4.4.1 Category 6A Component rated Slimline Patch Cords as described above in Horizontal Cabling section shall be used for HDBaseT interconnections in the transition from HDMI or VGA into UTP cabling.

2.7.4.5 HDMI Cable Assemblies

2.7.4.5.1 Cable shall be High-Speed HDMI with Ethernet and shall be HDMI certified.

2.7.4.5.2 The cable shall be rated CL2 for in-wall installations, be cULus Listed to UL 1863 and CAN/CSA C22.2 No. 233-09.

2.7.4.5.3 HDMI cables shall be manufactured with gold plated Type A male HDMI connectors with molded TPE connector outer body.

2.7.4.5.4 HDMI cables shall be manufactured with 28ga conductors and have an outside diameter of no greater than 0.27 inch

2.7.4.5.5 HDMI cables shall support Audio Return Channel.

2.7.4.5.6 HDMI cables shall be available with optional universal locking kit for adapting to a wide range of HDMI connector overmold sizes. Locking kit shall include both M3X0.5 and 40-40UNC screws.

2.8 FRAMES, RACKS AND CABINETS

2.8.1 FLOOR-MOUNTED 4-POST RACKS

2.8.1.1 Open 19 inch 4-post frame with #12-24 tapped hole extruded aluminum mounting rails designed to provide nearly 360 degrees of accessibility and unrestricted air flow.

2.8.1.2 84 inch (2133mm) 45RMU height with EIA/ECA-310-E universal 5/8 inch (16mm), 5/8 inch (16mm), ½ inch (13mm) hole pattern. Permanently stamped rack mount unit (RMU) markings and (100) #12-24 mounting screws included.

2.8.1.3 Depth adjustable in 1 inch (25.4mm) increments from 30 inch (762mm) to 36 inch (914mm) overall depth.

2.8.1.4 Load Rating: 2000 lb. (907kg) capacity, evenly distributed along rack height.

2.8.1.5 UL Listed to the UL60950 Standard - File No. E171936.

2.8.2 FLOOR-MOUNTED 2-POST RACKS

2.8.2.1 Universal junction hole pattern matches most manufacturers racks. #12-24 panel mounting holes. Conformance to EIA/ECA-310-E and UL Listed (File No. E171936) as a communications circuit accessory.

2.8.2.2 Load Rating: 1200 Lbs. (544kg) weight capacity when evenly distributed for the height of the rack (84 inch (2133mm) and shorter).

2.8.2.3 Material: Aluminum. Twin top angles for rigidity.

2.8.2.4 Add (1) front/rear vertical wire manager on each side or between racks. See Wire Management, below.

2.8.2.5 Permanently stamped rack mount unit (RMU) markings included. Double sided universal (5/8 inch (16mm), 5/8 inch (16mm), ½ inch (13mm)) mounting spacing.

2.8.2.6 Includes 30 dog point combo head (Phillips and flat blade) mounting screws.

2.8.2.7 Tapped assembly holes eliminate the need for nuts and simplifies assembly and squaring.

2.8.3 WALL-MOUNTED CABINETS

2.8.3.1 19RU usable 36 inch tall, 30 inch depth, 24 inch wide, 19 inch hole pattern, locking Plexiglass door

2.8.3.2 Enclosure features fully welded, 16 gauge (1.5mm) cold rolled steel construction.

2.8.3.3 Mounts to wall as left hinged or right hinged opening with Heavy duty, field reversible hinge and lock system.

2.8.3.4 Rear section can easily be separated from the cabinet for simple installation onto a wall and rear sections feature removable plates with either multiple knockouts for conduit or bushing installation, or a high-density foam gland plate for ease of installing pre- terminated patch panels.

2.8.3.5 Gland Plate Kit shall be available to adapt cabinet to fit over existing installed or terminated cables, as needed.

2.8.3.6 Provisioned for 16 inch (406mm) on-center mounting and multiple wire management lances for cable tie points or accessory mounting. Provide one Vertical cable lacing bar for each wall mount cabinet

2.8.3.7 Fully adjustable EIA/ECA-310-E compliant mounting rail system with #12-24 tapped rails. UL listed to the UL60950

2.8.3.8 36 inch (914mm) high cabinets rated for 200 lb (91kg) load; 48 inch (1219mm) high cabinets are rated for 300 lb (136kg) load. 36# cabinet is standard, use 48 inch as required.

2.8.4 VERTICAL WIRE MANAGERS

2.8.4.1 Provide full height, front-and-rear, 8 inch wide Vertical Wire Managers at the side of and between each 2-post and/or 4-post termination rack or frame. If space will not allow, the 5 inch wide wire manager may be substituted at row ends only, leaving the 8 inch vertical wire manager between each rack. Owner approval in writing is required prior to this substitution.

2.8.4.1.1 The vertical cable management system shall be cULus listed, PCI rated for 94V-O, ABS rated for UL94HB, and compliant with ANSI/TIA/EIA 568-B standards.

2.8.4.1.2 Mounting hardware shall be included to insure the proper installation to infrastructure. It shall mount onto a standard TIA/EIA recognized equipment rack.

2.8.4.1.3 The management system shall offer an assortment of accessories, including a bend radius slack loop organizer, cable retainers, and shall accommodate top, bottom, side and pass-through cable routing. Dual hinged, cable concealing covers shall be included.

2.8.5 HORIZONTAL WIRE MANAGERS -

2.8.5.1 Provide 2RU duct-style horizontal wire managers above and below or between every 2RU of patch panel, as space allows.

2.8.5.1.1 Cable managers shall be flat, covered duct style with front and rear channels.

2.8.5.1.2 Do not coil or wind patch cords inside wire managers.

2.8.5.1.3 Use recessed flat wire manager as needed within enclosed cabinets to route patch cords to opposite sides, where the rings of the flat wire managers would interfere with cabinet door closure.

2.9 CABLE SUPPORTS

2.9.1 J-HOOKS

2.9.1.1 All cable shall be supported above ceiling on dedicated cable support hardware.

2.9.1.2 Cable saddles and J-hooks shall be used where cable tray or wire basket is not available. These must be supported on their own ceiling wires, threaded rod, or affixed to building structure by use of beam clamps (on metal beams) or wood screws (on wood beams). Affixing communication cable supports to existing ceiling support wires is not allowed.

2.9.2 CABLE TRAY

2.9.2.1 In Telecom Rooms, cable tray (ladder runway) shall be installed to support all cable running to racks and cabinets.

2.9.2.2 Cable tray to be added to all Telecom Rooms in places where cable is run horizontally.

2.9.2.3 Cable tray shall be aluminum, with 9 inch rung spacing. Rungs can be removed or repositioned to accommodate specific project or building requirements.

2.9.2.4 Cable shall be combed and bundled in all exposed runs outside walls, in TR/TE, and inside cabinets and wire managers.

2.9.2.5 All appropriate cable tray support hardware including angle brackets, rack-to-runway brackets, wall-to-runway brackets, elevation kits, junction splices, butt splices, and grounding jumpers shall be used for a complete and professional installation.

2.9.3 JACK/OUTLET BRACKETS

2.9.3.1 Above-ceiling cable termination locations shall be either wall-mounted or suspended from structure above the drop ceiling. Cables or terminations shall not rest on ceiling grid or equipment above ceiling grid.

2.9.3.2 For Wireless Access Points and other above-ceiling-mounted communications devices, cables shall land in an above-ceiling bracket which is affixed to dedicated cable support hardware.

2.9.3.3 Two category-rated jacks may be installed in each above-ceiling bracket. Each above- ceiling bracket will hold a 2-port Surface-Mount Box or 1-U MOS SMB for multimedia applications.

2.9.3.4 For wall-mounted device locations (above or below ceiling), devices needing to be mounted directly to a backbox will utilize the in-wall mounting bracket to secure the jack inside the backbox.

2.9.3.5 One category-rated jack can be installed in each in-wall backbox jack mounting bracket. For devices requiring (2) category-rated jacks, (2) in-wall brackets must be used.

2.10 POWER DISTRIBUTION UNITS (PDU)

2.10.1 Provide (1) PDU per rack or wall cabinet. Unswitched, non-surge suppressed. 19 inch Horizontal for wall cabinets and 48 inch Vertical for floor-mounted cabinets.

2.10.2 Utilize plug and receptacle style appropriate for installation circuits and equipment interfaces.

2.11 FIRESTOPPING

2.11.1 Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur. Such devices shall:

2.11.1.1 Meet the hourly rating of the floor or wall penetrated.

2.11.1.2 Permit the allowable cable load to range from 0 percent to 100 percent visual fill thereby eliminating the need to calculate allowable fill ratios.

2.11.1.3 Permit multiple devices to be ganged together to increase overall cable capacity.

2.11.1.4 Allow for retrofit to install around existing cables.

2.11.1.5 Include an optional means to lengthen the device to facilitate installation in thicker barriers without degrading fire or smoke sealing properties or inhibiting ability of device to permit cable moves, add-ons, or changes

2.11.1.6 Not require any additional action on the part of the installer to open or close the pathway device or activate the internal smoke and fire seal, such as, but not limited to:

2.11.1.6.1 Opening or closing of doors.

2.11.1.6.2 Twisting an inner liner.

2.11.1.6.3 Removal or replacement of any material such as sealant, caulk, putty, pillows, bags, foam plugs, foam blocks, or any other material.

2.11.1.7 Where single cables (up to 0.27 in. (7 mm) diameter) penetrate gypsum board/stud wall assemblies, a fire-rated cable grommet may be substituted. Acceptable products shall be molded from plenum-grade polymer and conform to the outer diameter of the cable forming a tight seal for fire and smoke. Additionally, acceptable products shall lock into the barrier to secure cable penetration.

2.11.2 Where non-mechanical products are utilized, provide products that upon curing do no re- emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction .

2.11.2.1 Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.

2.11.2.2 Utilize an EMT sleeve as a stub through a rated wall

2.11.2.3 Surround annular space between EMT sleeve and wall material with a hardening intumescent caulk.

2.11.2.4 Utilize re-enterable, non-hardening putty around cables inside a metal sleeve. Do not exceed 40 percent fill capacity of sleeve and follow all rated assembly requirements per Manufacturer, local codes, and AHJ.

2.11.3 Cable trays shall terminate at each barrier and resume on the opposite side such that cables pass independently through fire-rated pathway devices. Cable tray shall be rigidly supported independent from fire-rated pathway devices on each side of barrier.

2.12 LABELING:

2.12.1 Cables

2.12.1.1 Horizontal and backbone cables shall be labeled at each end according to Owner labeling standards (see below). The cable or its label shall be marked with its identifier.

2.12.1.2 Cable labels shall be machine-generated wrap-around labels with multiple cable ID's printed such that it can be viewable in place without turning the cable.

2.12.1.3 Label cables within 6 inch of termination point at both ends.

2.12.2 Faceplates

2.12.2.1 A unique location identifier shall be marked on each faceplate to identify its location in the cable plant.

2.12.2.2 Each port in the faceplate shall be labeled with its own unique identifier.

2.12.3 Racks, Panels, Blocks

2.12.3.1 A unique identifier shall be marked on each piece of connecting hardware to identify it as connecting hardware.

2.12.3.2 Each port on the connecting hardware shall be labeled with its own identifier to match the other end of the cable.

PART 3 - EXECUTION

3.1 ADDITIONAL INFORMATION

3.1.1 Refer to Section 27 00 00 for the following Part 3 - Execution information

3.1.1.1 General

3.1.1.2 Cable Pathways

3.1.1.3 Work Area Outlets

3.1.1.4 Installation Practices

3.1.1.5 Labeling

3.1.1.6 Firestopping

3.1.1.7 Sealing of Penetrations and Openings

3.1.1.8 Cable Supports

3.1.1.9 Cable Protection

3.1.1.10 Grounding

3.1.1.11 Documentation

3.1.1.12 Training

3.1.1.13 Cleaning

3.1.1.14 Project Closeout

3.2 CABLE HANDLING / CABLE MANAGEMENT

3.2.1 Proper cable handling is critical to maintaining the design integrity of high-performance cabling. Cable handling recommendations include:

3.2.1.1 Cable must be conditioned above 32 degrees F for 48 hours prior to installation.

3.2.1.2 Do not use excessive force when pulling cable. The maximum pull-force guideline for a 4-pair horizontal UTP should not exceed 110N (25lbf). Meeting this guideline avoids stretching conductors during installation and the associated transmission degradation.

3.2.1.3 The minimum bend radius for UTP should not exceed 4 times the cable outside diameter (O.D.) The O.D. of CAT 6A 100 ohm, balanced UTP cable is .30 in. (4 x .3 = 1.2 in. bend radius).

3.2.1.4 The minimum bend radius for fiber should not exceed 10x the cable outside diameter.

3.2.1.5 Traditional combing and dressing (bundling) of Category 6 and 6A cabling for a combed appearance is required in all exposed locations.

3.2.1.6 In TR, use appropriate horizontal cable management for patch cords on front of patch panels. Also, use appropriate cable management bar(s) for support of terminated horizontal cable.

3.2.1.7 Do not use vinyl or plastic cable ties due to the potential for over-cinching of cable bundles which can alter the cable geometry and degrade the system cabling performance. Use only hook and loop ("Velcro") fasteners for bundling of horizontal cables.

3.2.1.8 Store cable slack in an extended loop configuration to alleviate cable stress. Excessive cable slack in bundled loops or traditional 'service loops' to provide additional cable length in TR has been shown to degrade cabling performance and are not recommended.

3.3 SEPARATION OF DATA AND POWER CABLING

3.3.1 Design cable pathways to avoid potential sources of EMI. Avoid installing cable near sources of EMI (X-ray equipment, large motors/generators, electrical power cabling and transformers, Radio frequency (RF) sources and transmitters, lighting, copiers, etc.).

3.3.2 Physically separate power and data cabling according to relevant code and standard requirements when run in a common pathway.

3.3.2.1 Never run data and Class 1 power cabling in parallel closer than 2 inch.

3.3.2.2 Avoid crossing cables if possible. If necessary, always cross cables at 90 degrees.

3.3.2.3 Maintain a minimum of 5 inch separation between data cable and all ballast controlled lighting.

3.3.3 Minimum separation distances of telecommunications cabling from potential sources of EMI exceeding 5kVA:

3.3.3.1 24 inches away from Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways

3.3.3.2 12 inches away from Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway

3.3.3.3 6 inches away from Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway

3.3.3.4 47 inches away from Electrical motors and transformers

3.4 INSTALLATION OF STRUCTURED CABLING SYSTEM

3.4.1 PRE-INSTALLATION CONFERENCE

3.4.1.1 Schedule a conference a minimum of five (5) calendar days prior to beginning work of this section.

3.4.1.2 Agenda: Clarify questions related to work to be performed, scheduling, coordination, etc.

3.4.1.3 Attendance: Communications system installer, General Contractor, Owners Representatives and any additional parties affected by work of this section. Owner's Information Technology must be represented at a preconference meeting prior to scheduling of any work.

3.4.1.4 Copy of Leviton warranty application will be provided by Contractor.

3.4.1.5 Pre-Installation conference may be waived only by Owner.

3.4.2 WARRANTY

3.4.2.1 A lifetime performance warranty covering all components, equipment and workmanship shall be submitted in writing with system documentation. The warranty period shall begin on the system's first use by the Owner.

3.4.2.2 The project must be pre-registered with Leviton (or pre-approved manufacturer) by the installation contractor before installation has begun, and shall be concluded by contractor with uploading of test results to Leviton and a full project closeout. Warranty paperwork will be delivered directly from Leviton to the Owner.

3.4.2.3 Should the cabling system fail to perform within its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the Contractor shall promptly make all required corrections without cost to Owner.

3.4.3 DRAWINGS AND SPECIFICATIONS

3.4.3.1 The Contract drawings and specifications form an integral part of the contract documents. Neither the drawings nor the specifications shall be used alone. Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work. Work omitted from the drawings but mentioned or reasonably implied in the specifications, or vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirements on drawings, or specifications shall not relieve the Contractor of his or her responsibility of properly completing the Contract.

3.4.3.2 The Owner's Project Manager has the option of changing the location of Electrical and Communication outlets to within 3 meters of designed location prior to rough-in stage at no extra cost to Owner. Owner and Owner's Representative requests a chalk/rough-in walk prior to installation to verify locations.

3.4.3.3 The Contractor is responsible to take field measurements where equipment and material dimensions are dependent upon building dimensions and to coordinate and provide a chalk/rough-in walk prior to installation to verify locations.

3.4.3.4 The Contractor shall coordinate with General, Mechanical and Electrical trades as well as Furniture Layout Designer for final workstation outlet locations.

3.4.3.5 Where conflict exists between drawings and specifications the Contractor shall, make allowance for provision of the component, system, or installation process in a manner which will provide the highest monetary cost components, systems, or installation process. Contractor shall inform the Owner's Project Managers of the conflict and obtain approvals prior taking corrective measures.

3.4.4 OWNER REQUIREMENTS AND STANDARDS.

[This section will change based on owner standards and practices]

3.4.4.1 A minimum of Four (4) CAT6A UTP cables and jacks (2 Data, 2 Voice) shall be installed in all standard work area outlet locations on a 6-outlet flush mounted faceplate, including offices, utility services, and other common telecommunications locations. Jack configurations will be Voice positioned at the top of the faceplate and Data is to be positioned at the bottom of the faceplate. The two center positions are to remain blank for future use.

3.4.4.2 All modular furniture will have a single workstation outlet per cubicle, unless specifically noted otherwise. All partition-wall or demising-walled areas have workstation outlets specifically noted on the Exhibit /Floor Plans.

3.4.4.3 Two (2) CAT6A UTP cables and jacks shall be installed at all Wireless Access Point locations. Security camera and AV / Multimedia locations also require CAT6A cables and jacks, but may require fewer or more cables. Refer to drawings for specific details.

3.4.4.4 Wallphone outlet locations require a single cable and jack on a stainless steel studded wallplate. Other locations may require more cables and jack outlets. Refer to drawings for specific details.

3.4.4.5 Data jack #1 shall be ORANGE, Data jack #2 shall be BLUE. Voice jacks shall be IVORY. All termination wiring shall be T568B.

3.4.4.6 A minimum of 4 - 4 inch sleeves must be present in each IDF. Sleeves for penetration of walls and floors shall have a 100 percent spare capacity and shall be fire-stopped as per code. Contractor is to provide additional sleeves if the rooms do not meet or exceed minimum requirements

3.4.5 PATHWAYS AND TOPOLOGY

3.4.5.1 Utilize "thin film" lubricants only! It has been shown that cable-pilling lubricants will affect your testing as the cable needs several weeks to dry before attenuation levels recover. Use of incorrect cable lubricants will erode cable jacket and void cable warranty.

3.4.5.2 All cable and wire shall be concealed in conduits, floor ducts, paneling, ceiling or similar areas except at mutually agreed upon areas.

3.4.5.3 Fill capacity in conduit, modular furniture and other horizontal pathways should not exceed 40 percent. A maximum of 60 percent pathway fill is allowed to accommodate unplanned additions after initial installation. The CAT 6A cable is a larger O.D. (0.275 inch - 0.30 inch vs. 0.23 inch for typical for CAT6 cable). The increased diameter of CAT 6A cable will require appropriate design considerations when sizing conduit and other

pathways. In most installations, conduit sizes will have to be increased in order to accommodate all of the cables being installed. This will impact the design and material selection of the project. To calculate the fill ratio, divide the sum of the cross-sectional area of all cables, by the most restricted cross-sectional area of the pathway.

3.4.5.4 Fill ratios for Augmented CAT6 cable (CAT6A) requires 1 inch EMT for 4 cables and sized larger for additional cables as required to maintain a 60 percent fill ratio.

3.4.5.5 Flat-rung and/or solid bottom cable tray shall be utilized for large, high-density installations. J-hooks and other specific cable support hardware shall be used at all locations outside of cable tray.

3.4.5.6 Pathway design should not exceed two (2) 90 degree bends between pull points or pull boxes (PB). If more than two (2) 90 degree bends are required, install a pull box between bends.

3.4.5.7 Provide NEC-sized pullboxes for any run greater than 100 feet, or with more than two 90 degree bends.

3.4.5.8 J-hooks should be randomly spaced 60 inch or less. Do not exceed J-hook capacity for size and weight limitations.

3.4.5.9 Land wireless access cabling above ceiling, secured onto in-ceiling bracket. A slack loop in the horizontal cabling is not required. Utilize varying-length patch cords when installing wireless access point devices for flexibility in length.

3.4.5.10 Crimp-on plugs at wireless access points are not allowed. Terminate all WAP cabling onto jacks and ceiling-mount brackets and test all cables as appropriate.

3.4.5.11 Mixing of various Category cables in the same pathway is allowed as long as the applications are appropriate for each category of cable used.

3.4.5.12 Prior to placing any cable pathways or cable, the Contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.

3.4.5.13 Maintain a distance of at least 12 inches from all power conduits and cables, and 6 inches from all fluorescent lighting fixtures. Do not install power feeders 100 amps or greater above or within 5 feet of telecommunications backboard. Do not install telecommunications conduits above power panels or switchboards.

3.4.5.14 Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

3.4.5.15 The backbone subsystem shall include cable installed in a vertical manner between floor telecommunications room/closets (TCs or IDFs) and the main or intermediate cross-connect in a multi-story building and cable installed horizontally between telecommunications room/closets and the main or intermediate cross-connect in a long single story building.

3.4.5.16 Unless otherwise recommended by the Owner, all fiber cables will be encased in interlocking armor. All fibers will be terminated in the Telecom Rooms or Cabinets in rack-mounted enclosures equipped with sufficient ports to allow for growth, slack storage space and splice trays if required to terminate and secure all fibers.

3.4.5.17 Adequate riser sleeve/slot space shall be available with the ability to ingress the area at a later date in all Telecommunications rooms/closets, such that no drilling of additional sleeves/slots is necessary. Sleeves may need to be provided and installed under the scope of this Project.

3.4.5.18 The backbone cables shall be installed in a star topology, emanating from the main cross-connect to each telecommunications room/closet. An intermediate cross-connect may be present between the main cross-connect and the horizontal cross-connect.

3.4.5.19 For voice or data applications, 4 pair UTP or fiber optic cables shall be run using a star topology from the telecommunications room/closet serving that floor to every individual information outlet.

3.4.5.20 Backbone and Horizontal pathways shall be installed or selected such that the minimum bend radius is maintained both during and after installation.

3.4.5.21 All horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes.

3.4.5.22 Install ¾ inches x 4 feet x 8 feet fire-rated plywood across all walls in telecom rooms, from 6 inches AFF to 8 feet 6 inches AFF. Coat with two (2) coats of white paint. Do not paint over fire rating stamp.

3.4.5.23 Contractor shall firestop all used pathways which enter or leave the telecom rooms via conduit, cable tray or slot. Contractor is responsible for installing sleeves at each wall or partition penetration, and firestopping all fire-rated penetrations. Intumescent caulk shall be applied around the outside of each sleeve, and intumescent putty inside the sleeve or conduits around the cables. Appropriate fill ratios must be followed when penetrating fire- rated walls.

3.4.5.24 Do not run fiber cables in conduits which are less than 2 inches in diameter.

3.4.5.25 Abandoned cable shall be removed from pathways (i.e., from tunnels, manholes, plenum spaces, and conduit) under scope of this project. Previously unknown or unidentified cable which is apparently abandoned prior to work shall be brought to the attention of the Owner for authorization prior to removal.

3.4.6 GROUNDING:

3.4.6.1 Refer to section 27 05 26 for specifications on Grounding and Bonding.

3.4.6.2 All grounding (earthing) and bonding shall be done to applicable codes, standards and regulations.

3.4.6.3 Shielded cabling channels shall include appropriate method of bonding shield to approved ground for proper EMI/RFI mitigation.

3.4.6.4 Shield Continuity Testing shall be Enabled when shielded cabling channels are installed.

3.4.6.5 All shielded and armored cables shall be bonded to a telecom grounding system via shielded patch panels at the rack locations. Shielded Category-rated connectors must be properly installed to maintain electrical ground conductivity along entire length of cable and at both ends of the cable. UTP connectors shall not be used on shielded cables at either end.

3.4.6.6 Shielded Patch cords shall be provided for use and employed at each workstation location utilizing shielded cable. Shielded patch cords can be identified by their gray color and metallic RJ45 plug. Shielded patch cords are not required at the patch panels.

3.4.6.7 Telecom Contractor shall bond and ground all telecom room metals. Telecom Contractor shall provide and install TIA-rated Telecommunications Grounding Busbar (TGB) at all MDF and IDF locations, and an in-cabinet grounding busbar at each remote wall-mounted cabinet or telecom enclosure. All ground lugs shall be 2-hole make-up.

3.4.6.8 Electrician will provide connection between TGB and building ground; Telecom Contractor (if separate, otherwise electrician) will provide a busbar and ground all equipment and telecom metals to the busbar.

3.4.6.9 Telecom installer will ground and bond all armored and/or shielded cables, racks, cabinets, cable tray, ladder racking, and shielded panels to telecom grounding busbar.

3.4.7 CABLES AND TERMINATIONS:

3.4.7.1 Check plans and symbology for final determination of faceplate constitution or consult with Owner prior to bid.

3.4.7.2 Install additional cables at drop locations and in quantities indicated on the drawings. Do not exceed manufacturers' recommendations for maximum allowable pulling tension, side wall pressure or minimum bending radius. Use pulling compound as recommended by cabling manufacturer.

3.4.7.3 All horizontal cables, regardless of media type, shall not exceed 90 m (295 ft) from the telecommunications outlets in the work area to the horizontal cross connect.

3.4.7.4 The combined length of jumpers, or patch cords and equipment cables in the telecommunications room/closet and the work area shall not exceed 10m (33 ft).

3.4.7.5 The Contractor shall observe the bending radius and pulling strength requirements of the 4 pair UTP and fiber optic cable during handling and installation.

3.4.7.6 No run of UTP cable between horizontal portions of the cross-connect in the telecommunication closet and the information outlet shall contain splices.

3.4.7.7 In a false ceiling environment, a minimum of 3 inches (75 mm) shall be observed between the cable supports and the false ceiling. Minimum 6 inch is preferred.

3.4.7.8 J-hooks shall be provided for all suspended cable, at a semi-irregular spacing not to exceed 5 feet between supports. Cables shall be supported by dedicated low-voltage cable support hardware. Support of cables or hanging hardware by means of supports or surfaces related to other trades or applications is not allowed.

3.4.7.9 Provide a full-size service loop (at least once around the inside edge of the box) in each J-box in the communications system.

3.4.7.10 Install all cable in plenum spaces with J-hooks of at least 1 inch in width to disperse the weight on the bottom cables. Homerun all cable to nearest TR Cabinet.

3.4.7.11 Comply with ANSI/TIA-569 for conduit and splice box sizing.

3.4.7.12 Install modular jacks at all outlets shown; one data jack for each data cable at each faceplate or termination point. Install additional cables and modular jacks as indicated on the drawings. Do not "split pairs" between different jacks.

3.4.7.13 Terminate cables at each jack location and at termination board or patch panel. Follow industry guidelines and manufacturers' recommendations and procedures as required. All termination hardware shall be rated to exceed their associated Category rating as specified above.

3.4.7.14 Field-installable RJ45 plugs are not to be used.

3.4.7.15 For enclosed ceiling WAP locations, install and terminate CAT6A cables to approximate location as shown on plans. For open-ceiling environments, secure cables and surface- mount boxes to nearest appropriate support structure.

3.4.7.16 For in-ceiling WAP locations, secure jacks inside a surface-mount block mounted to in- ceiling metal assembly, and provide a 5 foot patch cord or longer, as needed, to connect device to its final determined location in ceiling.

3.4.7.17 For wall-mounted device locations, utilize an in-wall bracket in lieu of faceplate as described above. Secure mounting bracket and device hardware directly over backbox. Connect device with 1 foot CAT6A cord (Security, AV, or WAP), or 1 foot high-flex CAT6 patch cord for other CAT6-based devices. Coil patch cord inside backbox.

3.4.7.18 Label and identify each outlet and cable for data circuits. Label at outlet end and at termination board or patch panel with matching designations.

3.4.7.19 Provide data outlets in surface raceway at 26 inches on center unless otherwise indicated.

3.4.7.20 Extreme care must be taken not to nick any of the copper conductors when removing jacket. Use rip cord to expose pairs for termination onto Insulation Displacement Contacts. You can also use a precision stripper that allows the technician to set the depth of the blade.

3.4.7.21 Maintain twists as close as possible to the point of termination. Untwisting of copper pairs should not exceed ¼ inch to the termination point.

3.4.7.22 Manage the cable bundles in a symmetrical orientation. For example, in a 48-port patch panel, distribute 24 cables through the vertical cable management on the left rear side of the rack and 24 cables through the vertical cable management on the right rear side of the rack.

3.4.7.23 Do not dress cables in bundles larger than 24 cables. Multiple 24-cable bundles may be run in parallel with evenly-spaced Velcro cable ties in an orderly sequence.

3.4.7.24 For cable management on rear of patch panel, cable shall sweep into termination points and be supported by appropriate rear cable management.

3.4.7.25 Horizontal patch cord management is required on all installations which do not use angled patch panels.

3.4.7.26 Maintain cable bend radius 4X outer diameter (UTP only) when mounting faceplate onto EMT backbox, box-eliminators or furniture knock-outs.

3.4.7.27 Faceplates and SMBs shall be fully installed and labeled prior to testing.

3.4.8 ABOVE-CEILING AND WALL-MOUNTED WIRELESS ACCESS POINTS AND DEVICES

3.4.8.1 All WAP locations shall receive two (2) Category 6A cables from the nearest TE or TR (IDF). Multimedia, security and other video devices shall receive CAT6A cables as shown on drawings, documents and details.

3.4.8.2 Clock/Speakers and other low-bandwidth mounted devices shall receive one (1) CAT6A cable.

3.4.8.3 WAP, IP Camera and other communications cables shall terminate on patch panels in the TE/TR (IDF).

3.4.8.4 WAP cables shall terminate on Category 6A information outlets and shall be supported by an in-ceiling termination bracket. Affixing of a 2-port SMB to the bracket is recommended.

3.4.8.5 SMB, jacks, and patch cords used in plenum spaces shall be plenum-rated.

3.4.8.6 SMB shall be mounted in the ceiling on a specially-designed clip attached to a cable support ceiling wire or threaded rod support per cable management section in Part 2. SMB shall not be tie wrapped to supports, or left on ceiling tiles or other equipment located above the ceiling.

3.4.8.7 Wall-mounted devices not requiring faceplates will be mounted directly to the backbox. Jacks will be secured inside backbox on a specially-designed in-wall bracket clip per cable management section in Part 2.

3.4.8.8 Contractor shall mount Access Point (AP) electronics to the drop ceiling suspended T- grid system. (AP and mounting hardware provided by Contractor). Contractor to provide and install (2) green CAT 6A patch

cords from the overhead WAP outlets to the AP. Contractor shall neatly cut holes into the ceiling tile and finish the holes with grommets or other industry-standard finishing piece for a professional look.

3.4.9 AUDIO-VISUAL DEVICES

3.4.9.1 HDBASE-T DEVICES

3.4.9.1.1 Follow manufacturer's user's manual for proper installation.

3.4.9.1.2 One DC 24V power adaptor is required and can be attached at either end as the other can be energized via the PoH function of the interconnecting twisted pair cable.

3.4.9.1.3 For best performance, Category 6A (isolation wrap or shielded) twisted pair cable should be installed in accordance with applicable ANSI/TIA-568 standards and be field certified to 500 MHz using approved testers.

3.4.9.1.4 Properly secure HDMI cables to devices with lock kit brackets and tie wraps.

3.4.9.1.5 Installation methods shall adhere to NFPA National Electrical Code and all local building and fire codes.

3.4.9.2 STANDARD AV EXTENSION DEVICES

3.4.9.2.1 Follow manufacturer's instruction sheet for proper installation and adjustment.

3.4.9.2.2 For best performance, Category rated twisted pair cable should be installed in accordance with applicable ANSI/TIA-568 standards and be field certified using approved testers.

3.4.9.2.3 Install DC power adaptor(s) as required.

3.4.9.2.4 Properly secure all cables with appropriate strain relief methods.

3.4.9.2.5 Installation methods shall adhere to NFPA National Electrical Code and all local building and fire codes.

3.4.9.3 MIXING AUDIO AMPLIFIERS

3.4.9.3.1 Follow manufacturer's instruction sheet for proper installation and sound level adjustment.

3.4.9.3.2 Install DC power adaptor(s) as required.

3.4.9.3.3 Properly secure all cables with appropriate strain relief methods.

3.4.9.3.4 Installation methods shall adhere to NFPA National Electrical Code and all local building and fire codes.

3.4.9.4 HDMI CABLES

3.4.9.4.1 Follow manufacturer's instruction sheet for proper installation

3.4.9.4.2 Secure HDMI cables to active device ports with cable locking kits or industry best practice to mitigate inadvertent cable disconnects.

3.4.9.5 HDBASET CABLING CHANNELS

3.4.9.5.1 100 percent of cabling channels shall be tested to meet or exceed ISO/IEC Class EA performance parameters.

3.4.9.5.2 Cabling shall be installed in accordance with manufacturer's recommendations and best industry practices as well as compliance with all applicable sections of this Specification regarding Category-rated structured cabling.

3.4.9.5.3 When cables are being installed, slack (service loops) shall be provided at both ends to accommodate future changes in the structured cabling system.

3.4.10 FURNITURE CABLING

3.4.10.1 The Contractor will pull all voice and data cables in advance of the installation of the modular furniture workstations, and coil at basefeed or above ceiling for power pole feeds. Upon furniture arrival, the Contractor will feed the cables through power poles or base feed/wall connected data/telecom conduit, and terminate as specified on the floor plans.

3.4.10.2 Contractor to coordinate with Owner's furniture vendor for timing of the installation of systems furniture, and installation of electrical and voice/data cabling. Overtime may be required for this and other phases of the project work, and bids, plans and schedules must reflect actual work demands. Contractor shall consider all costs in their bids for installation.

3.4.11 TERMINAL BLOCKS AND PATCH PANELS:

3.4.11.1 Arrange all terminal blocks in a manner that allows natural wiring progression and minimizes crossing of wires.

3.4.11.2 Dress and comb all incoming cable bundles in groups of 24 cables each. Eliminate crossed cables and "divers".

3.4.11.3 Ground all shielded patch panels to telecom ground source via paint-piercing washers to a grounded rack, or via direct ground wire to telecom bus bar.

3.4.12 IDF ROOMS

3.4.12.1 The Data and Telco Rooms are a transition point between the backbone and horizontal distribution pathways. The rooms shall be able to contain data or telecommunications' equipment, cable terminations and associated cross-connection wiring. Closet spaces are not to be shared with electrical installations, other than those directly for telecommunications, video, security and information systems equipment. The rooms are not to be shared with other unrelated building service, for example plumbing. Any conflicts with these specifications require the approval of the Owner's Project Manager.

3.4.12.2 Contractor shall submit a drawing of the IDF room showing layout of all components including necessary and required electrical outlets, conduits, environmental requirements and wire termination fields prior to start of the job. Any jack densities noted in these specifications are estimates only. The drawing will designate the most effective, scalable, jack termination cabling design to facilitate data/telecom outlets shown on the lease exhibits. Owner's Project Managers must approve drawings prior to installation.

3.4.12.3 All racks, panels, and equipment finished shall be anchored to meet local seismic zone requirements and industry standards. The equipment racks are to be anchored to the concrete floors via "Unistrut or equal metal framing strut systems", threaded rod, concrete anchors, bolts and washers.

3.4.12.4 The overhead cable ladder system will provide a route for the Category 6 and 6A, and other communication cables while providing stability to the equipment racks.

3.4.12.5 The vendor is responsible to provide and install the specified count of 19 inches EIA rack-mount 7 ft (45U) 2- post racks, Black, as required in the new IDF. The vendor is responsible for submitting IDF layout drawings to Owner for approval prior to installation.

3.4.12.6 The Contractor shall provide high capacity horizontal and vertical cable manager channels are required in all data and equipment racks, and the racks will contain sufficient vertical and horizontal cable managers to facilitate the patch panel density and placement installed by the Contractor.

3.4.12.7 Contractor will install raceways, boxes, managers, and enclosures as indicated according to manufacturer's written instructions. Securely fasten each component to the surface to which it is mounted and remove burs and sharp edges from all cable tray.

3.4.12.8 A 12 inch ladder rack system is required and will be provided by the Contractor and installed in the IDF to provide cable support to the rack system. This includes all of the required ladder rack support items such as rack to runway kits, wall angle brackets, ceiling supports, splices (junction and butt), radius drops and j-bolts. The final ladder rack layout will be included in the IDF layout drawing described above.

3.4.12.9 Provide and install as needed in the IDF room 4 ft x 8 inches x ¾ inch fire-rated plywood board and labeled with fire rating stamp facing into the room to accommodate rack ladder support, cabling support, grounding platform, data and voice equipment. Paint backboard white (leave stamp visible) to match existing backboard in room, if appropriate. Location of installation is to be determined with approval by Owner.

3.4.13 PATCH CORDS:

3.4.13.1 Contractor to provide and install fiber and copper patch cords in quantities as described below. Neatly install patch cords in lengths as appropriate to reduce unnecessary length in wire managers.

3.4.13.2 Install patch cords at the equipment cabinet between patch panel and Owner-provided switches for each patch panel and workstation location. Patch cords shall direct-connect between patch panel and networking switch or other electronics equipment. Dress and bundle patch cords as appropriate for final installation. Provide any unused equipment patch cables to Owner in original packaging upon completion of project.

3.4.13.3 Install Wireless Access Point patch cords as described above, and connect Cameras and other field-installed networkable device via a vendor-supplied patch cord at the remote locations. Return unused patch cords to Owner in original packaging.

3.4.13.4 Provide workstation patch cords to Owner in original packaging.

3.4.13.5 Use the following guidelines for project bid. Verify all lengths with Owner prior to purchase:

3.4.13.5.1 Provide and install one (1) 7-foot patch cord, of the same category rating, for each cable terminated at the patch panel

3.4.13.5.2 Provide one (1) 10-foot patch cord, of the same category rating, for each cable terminated at the terminal outlet location

3.4.13.5.3 Provide one (1) 2-meter patch cord, of the same grade of fiber, for each LC connector pair installed at the IDF, MDF, and all other terminal enclosure locations.

3.4.13.6 All fiber patch cords and required workstation/equipment patch cords not installed shall be provided in hand to Owners Representative prior to project closeout.

3.4.14 LABELING

3.4.14.1 Provide machine-generated labels appropriate for all components supplied and installed. Under no circumstances shall hand written labels be used.

3.4.14.2 Each faceplate, cable, or data outlet (drop) will be numbered with a unique identifier clearly indicating the voice and data jacks by floor number, station, and outlet identification. This labeling scheme will be independent of any assigned telephone numbers.

3.4.14.3 The labeling scheme shall not include duplicates of any new or existing cable identification across the entire cable plant.

3.4.14.4 Labeling procedure will meet TIA-568, TIA-606 (Class 2 Administration) and BICSI Standards.

3.4.14.5 The labeling scheme will be provided at all locations within the cable infrastructure:

3.4.14.6 Labeling will be as follows:

3.4.14.6.1 The numbering scheme will be Floor Number, Jack Number.1 or .2. (7:###. 1 and 7:###.2)

3.4.14.6.2 Label patch panel RJ-45 jacks numbered sequentially with 2 data jacks per station in line, designated by".1" and ".2".

3.4.14.6.3 Label Wireless Access Point cabling as AP01.1 / AP01.2, AP02.1/AP02.2, etc.

3.4.14.6.4 Label Racks containing patch panels as "DATA" and "VOICE".

3.5 VERIFICATION OF IDF ENVIRONMENT

3.5.1 All inspections which expose existing conditions not meeting Owner standards as described above must be reported to the Owner prior to installation. Owner may require additional work to bring existing site conditions up to Standard. Areas to explore shall include, but not be limited, to the following items.

3.5.2 Insufficient or failed HVAC flow in the IDF with the appropriate exhaust system. Air temperatures shall not exceed 78 degrees sustained.

3.5.3 It is recommended to recess any existing or new fire sprinklers in the IDF to prevent accidental damage and associated risks.

3.5.4 Lighting layout fixture pattern is to provide sufficient lighting over front and back of each equipment rack.

3.5.5 In the IDF room, a minimum of (2) 20-amp, dedicated, duplex power outlets box must be provided to support network electronics. Outlet boxes must be installed on the top of the equipment rack in a location approved by Owner and the Network Support (IT) representative.

3.5.6 All existing racks, cable tray, and metal structures shall be appropriately anchored and bonded to telecom ground and in sufficient size, quantity and configuration according to Owners standards as described above.

3.5.7 Any penetration of fire and smoke barrier must be approved by the Lessor and/or Owner. Such penetrations must be properly treated according to industry standards, all applicable codes and with the current addition of the National Electrical Code. Minimally, metallic sleeves patched-in with fireseal putty, and filled with pliable intumescent materials meeting the applicable codes shall be used. In all cases, the Contractor shall be responsible for compliance with all federal, state and local regulations in effect.

3.5.8 During installation, any penetration of fire wall shall be sealed with approved firestop material by the end of each working day: that is, fire walls shall not be left with a vulnerable point overnight.

3.6 TESTING

3.6.1 COPPER TESTING

3.6.1.1 Test all equipment and each outlet, horizontal cable, termination block, patch cords, etc. to verify compliance with requirements. Testing shall consist of attenuation and NEXT across all splices and devices installed in the field and shall meet latest requirements of EIA/TIA. Re-terminate any cable or connection found to be defective.

3.6.1.2 Tester is to be a Level IV device or better, and configured with the specific cable installed, and the Permanent Link test will be performed according to the Category's standard methodology. All parameters must exhibit a PASS test result prior to project completion. PASS*, FAIL* or FAIL test results will not be accepted.

3.6.1.3 Only a permanent link test for Category 6A will be required. If situations demand a "hybrid", "Mixed" or a standard "Channel" design, approval must be obtained for those specific circumstances prior to testing.

3.6.2 FIBER OPTIC TESTING

3.6.2.1 Each pre-terminated fiber strand shall be tested for continuity and attenuation with an Optical Power Meter and light source for actual length and splice/connector loss. Each field-terminated fiber strand (if any) shall be tested for attenuation with an Optical Power Meter and

light source and with an Optical Time Domain Reflectometer (OTDR) for actual length and splice/connector loss.

3.6.2.2 Cable length shall be verified using sheath markings. The guidelines and procedures established for Tier 1 testing in TIA/TSB-140 shall apply.

3.6.2.3 All fiber optic cables shall be tested from the site's MDF to each fiber terminals located in the IDF.

3.6.2.4 The Contractor shall conduct a bi-directional power meter (loss) test of each fiber optic station and riser cable at both wavelengths, 850/1300nm for MM and 1310/1550nm for SM.

3.6.2.5 No individual station or riser fiber link segment (including connectors) shall measure more than 2.0 dB loss for LC, and 1.5dB loss for MTP. LC links shall be tested with LC jumpers from the LC cassette to the tester. MTP links shall be tested either with an MTP tester and array cord, or with an MTP-LC breakout harness and LC duplex fiber tester.

3.6.2.6 Tests shall be conducted using ANSI/TIA-526-14A, Method B. Test results evaluation for the panel to panel (backbone) shall be based on the values set forth in ANSI/TIA-568.

3.6.2.7 The Contractor shall provide an electronic printout for each strand tested with the Power Meter and the OTDR.

3.6.2.8 Where concatenated links are installed to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. After the link performance test has been successfully completed, each link shall be concatenated and tested. The test method shall be the same used for the test described above. The evaluation criteria shall be established between the Owner and the Contractor prior to the start of the test.

3.6.2.9 All installed cables must meet or exceed the defined standards for performance. The Contractor shall take all steps and all expense necessary to clean, repair or replace any optic link not meeting the standard.

3.6.3 TEST RESULTS

3.6.3.1 Repair and resolve any shortcomings in the test results. Mitigation efforts may require re- termination or replacement of the jack, outlet or cable. Repairs or attempts to resolve test failures will be completed solely at the expense of the Contractor.

3.6.3.2 Provide test results to Manufacturer and Owner representative in native Tester format. Upon request, provide a copy of the tester software and license, if needed, at no charge to Owner representative.

3.6.3.3 Include PDF of full test results, summary index in electronic format on CD or memory stick in the O&M package upon project completion.

3.6.3.4 Cabling systems shall meet or exceed the electrical and transmission characteristics of the systems specified.

3.6.3.5 Cable segments and links shall be tested from both ends of the cable for each of the construction phases. (Verify that cable labeling matches at both ends).

3.6.3.6 The system shall not be considered certified until the tester has acknowledged that the performance of the physical layer of the system has been fully tested and is operational at the completion of the installation phase.

3.6.3.7 After the installation is complete, in addition to any other required testing as described herein, and at such times as the Owner/Engineer directs, the Contractor shall be present while the Owner conducts an operating test for approval. The installation shall be demonstrated to be in accordance with the requirements of this specification. Any defects revealed shall be corrected promptly at the Contractor's expense and the tests performed again.

3.6.3.8 After review of the completed test results, the Owner reserves the right to retest cables, utilizing the Contractor's tester and the Contractor's labor.

3.6.3.9 The test results information for each link shall be recorded in the memory of the field tester upon completion of the test. The tester shall be capable of storing test data in either internal or external memory. The external media used shall be left to the discretion of the user.

3.6.3.10 Test results saved by the tester shall be transferred into a Windows based database utility that allows for maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered as well as any printed reports generated from the software application.

3.6.3.11 Test results shall be provided in both native Tester format as well as comma separated variable (.csv), Portable Document File (.pdf), plain text (.txt), or hypertext markup language (.html/.htm). A copy of the tester native test software must be provided to Owner or Owner's representative for comparison of results.

3.6.3.12 Test Results for CAT6 shall include the following:

3.6.3.12.1 Applicable room number of jack location (room number per Contract Documents)

3.6.3.12.2 Applicable Telecommunications Room number

3.6.3.12.3 Circuit I.D. number with corresponding jack identifier

3.6.3.12.4 Wire Map - shall include the following:

3.6.3.12.4.1 Continuity to the remote end

3.6.3.12.4.2 Shorts between any two or more conductors

3.6.3.12.4.3 Crossed pairs

3.6.3.12.4.4 Reversed pairs

3.6.3.12.4.5 Split pairs

3.6.3.12.4.6 Any other mis-wiring

3.6.3.12.5 Length

3.6.3.12.6 Insertion Loss

3.6.3.12.7 Near-end Crosstalk (NEXT) Loss

3.6.3.12.8 PS-NEXT (Power Sum Near End Cross Talk)

3.6.3.12.9 FEXT (Far End Crosstalk)

3.6.3.12.10 ELFEXT (Equal Level Far End Cross Talk)

3.6.3.12.11 PS-ELFEXT (Power Sum Equal Level Far End Cross Talk)

3.6.3.12.12 Propagation Delay

3.6.3.12.13 Delay Skew

3.6.3.12.14 Return loss

3.6.3.12.15 PSFEXT (Power Sum Far End Crosstalk)

3.6.3.12.16 PSACRF (Power Sum Attenuation to Crosstalk Ratio, Far End)

3.6.3.13 Test Results for CAT6A shall include all of the above, plus the following:

3.6.3.13.1 AACRF (Alien Attenuation to Crosstalk Ratio, Far End)

3.6.3.13.2 AFEXT (Alien Far End Crosstalk)

3.6.3.13.3 ANEXT (Alien Near End Crosstalk)

3.6.3.13.4 PSANEXT (Power Sum Alien Near End Crosstalk)

3.6.3.13.5 PSAACRF (Power Sum Alien Attenuation to Crosstalk Ratio, Far End)

Approved Tester Products:

Fluke DTX or later platform Cable Certification testers

3.7 PROJECT CLOSEOUT

3.7.1 Operating and maintenance manuals shall be submitted prior to testing of the system. A total of four (4) manuals shall be delivered to the Owner. Manuals shall include all service, installation, and programming information.

3.7.2 Provide a full set of "as-built" (redline) drawings in AutoCAD DWG and PDF format. Drawings to depict final location and drop/cable identification numbers and labels which match the test reports. Include one (1) hard copy paper format of all as-builts in 30 inch x 42 inch size or equivalent, posted in each telecom room involved in the project.

3.7.3 Contractor to provide all warranty information to Leviton for processing. Leviton will send warranty document direct to Owner.

3.8 TRAINING

3.8.1 Provide 4 hours training on the operation and installation of the data system, at job site, at no cost to Owner.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

1.1.1 Telecommunications service entrance to building(s).

1.1.2 Cabling and pathways inside building(s).

1.1.3 Cabling and pathways connecting building(s).

1.1.4 Distribution frames, cross-connection equipment, enclosures, and outlets.

1.1.5 Grounding and bonding the telecommunications distribution system.

1.2 RELATED REQUIREMENTS

1.2.1 Section 33 71 19 - Electrical Underground Ducts and Manholes.

1.2.2 Section 07 84 00 - Firestopping.

1.2.3 Section 26 05 26 - Grounding and Bonding for Electrical Systems: Electrical system grounding and bonding.

1.2.4 Section 26 05 34 - Conduit.

1.2.5 Section 26 05 37 - Boxes.

1.2.6 Section 26 27 26 - Wiring Devices.

1.3 REFERENCE STANDARDS

1.3.1 EIA-310 - Cabinets, Racks, Panels, and Associated Equipment; Electronic Industries Association; Revision D,

1.3.2 CEA-310 - Cabinets, Racks, Panels, and Associated Equipment; Consumer Electronics Association; Revision E

1.3.3 ICEA S-90-661 - Category 3, 5, & Se Individually Unshielded Twisted Pair Indoor Cable for Use in General Purpose and LAN Communications Wiring Systems; Insulated Cable Engineers Association

1.3.4 NFPA 70 - National Electrical Code, 2005 with 2007 California Electrical Code amendments.

1.3.5 TIA-455-21 - FOTP-21 - Mating Durability of Fiber Optic Interconnecting Devices; Rev A,

1.3.6 TIA-492AAAA - Detail Specification for 62.5-um Core Diameter/125-um Cladding Diameter Class la Graded-Index Multimode Optical Fibers; Revision A,

1.3.7 TIA-492AAAB - Detail Specification for 50-um Core Diameter/125-um Cladding Diameter Class la Graded-Index Multimode Optical Fibers

1.3.8 TIA-492CAAA - Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers

1.3.9 TIA-526-7 - OFSTP-7 - Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

1.3.10 TIA-526-14 - OFSTP-14 - Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; Rev A,

1.3.11 TIA/EIA-568-B.1 - Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements

1.3.12 TIA/EIA-568-B.2 - Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cabling Components

1.3.13 TIA/EIA-568-B .3 - Commercial Building Telecommunications Cabling Standard - Part 3: Optical Fiber Cabling Components Standard, and Addendum 1 - Additional Transmission Performance Specifications for 50/125 um Optical Fiber Cables;

1.3.14 TIA-569 - Commercial Building Standard for Telecommunications Pathways and Spaces;

1.3.15 TIA/EIA-606 - Administration Standard for the Telecommunications Infrastructure

1.3.16 ANSl/J-STD-607 - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

1.3.17 UL 444 - Communications Cables; Current Edition, Including All Revisions.

1.3.18 UL 497 - Standard for Protectors for Paired-Conductor Communications Circuits; Current Edition, Including All Revisions.

1.3.19 UL 514C - Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

1.3.20 UL 1581 - Reference Standard for Electrical Wires, Cables, and Flexible Cords; Current Edition, Including All Revisions.

1.3.21 UL 1863 - Standard for Communications-Circuit Accessories; Current Edition, Including All Revisions.

1.3.22 USDA RUS 345-83 - Gas Tube Surge Arrestors (PE-80); US Department of Agriculture

1.4 SUBMITTALS

1.4.1 See Section 01 30 00 - Administrative Requirements, for submittal procedures.

1.4.2 Product Data: Manufacturer's data sheets on each product to be used, including:

1.4.2.1 Installation methods.

1.4.3 Shop Drawings: Show compliance with requirements on isometric schematic diagram of network layout, showing cable routings, telecommunication closets, rack and enclosure layouts and locations, service entrance, and grounding, prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).

1.4.4 Manufacturer Qualifications.

1.4.5 Installer Qualifications.

1.4.6 Test Plan: Complete and detailed plan, with list of test equipment, procedures for inspection and testing, and intended test date; submit at least 60 days prior to intended test date.

1.4.7 Field Test Reports.

1.4.8 Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).

1.4.8.1 Record actual locations of outlet boxes and distribution frames.

1.4.8.2 Show as-installed color coding, pair assignment, polarization, and cross-connect layout.

1.4.8.3 Identify distribution frames and equipment rooms by room number on contract drawings.

1.4.9 Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of project record documents.

1.5 QUALITY ASSURANCE

1.5.1 Manufacturer Qualifications: At least 3 years' experience manufacturing products of the type specified.

1.5.2 Installer Qualifications: A company having at least 3 years' experience in the installation and testing of the type of system specified, and:

1.5.2.1 Employing a BICSI Registered Communications Distribution Designer (RCDD).

1.5.2.2 Supervisors and installers factory certified by manufacturers of products to be installed.

1.5.2.3 Employing experienced technicians for all work; show at least 3 years' experience in the installation of the type of system specified, with evidence from at least 2 projects that have been in use for at least 18 months; submit project name, address, and written certification by user.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Store products in manufacturer's unopened packaging until ready for installation.

1.6.2 Keep stored products clean and dry.

1.7 WARRANTY

1.7.1 See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

1.7.2 Correct defective Work within a 2 year period after Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.1.1 Cabling and Equipment:

2.1.1.1 3M Telecommunications:
solutions.3m.com/wps/portal/3M/en_US/Telecom/Home.

2.1.1.2 AMP Netconnect/Tyco Electronic Corporation: www.ampnetconnect.com.

2.1.1.3 Siemon Company: www.siemon.com.

2.1.1.4 Substitutions: See Section 01 60 00 - Product Requirements.

2.2 SYSTEM DESIGN

2.2.1 Provide a complete permanent system of cabling and pathways for voice and data communications, including cables, conduits and wireways, pull wires, support structures, enclosures and cabinets, and outlets.

2.2.1.1 Comply with TIA/EIA-568 and TIA/EIA-569, latest editions.

2.2.1.2 Provide fixed cables and pathways that comply with NFPA 70 and ANSl/J-STD- 607 and are UL listed or third party independent testing laboratory certified.

2.2.1.3 Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F at relative humidity of 0 to 95 percent, noncondensing.

2.2.1.4 In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.

2.2.2 Capacity:

2.2.2.1 Building Entrance: _____ pairs, backbone cable.

2.2.2.2 Backbones: _____ pairs, copper.

2.2.2.2.1 Provide optical fiber backbone cabling between buildings and copper backbone cabling within buildings.

2.2.2.3 Horizontal Cabling: Copper.

2.2.2.4 Offices and Work Areas: Provide one voice outlet and one data outlet in each work area, unless noted otherwise or as shown on plan.

2.2.2.5 Classrooms: voice and data outlets as shown on plan.

2.2.2.6 Provide additional outlets where indicated on drawings.

2.2.3 Main Distribution Frame (MDF): Centrally located support structure for terminating backbone cables, functioning as point of presence to external service provider.

2.2.3.1 Capacity: As required to terminate all cables required by design criteria plus minimum 25 percent spare space.

2.2.4 Intermediate Distribution Frames (IDF): Support structures for terminating horizontal cables that extend to telecommunications outlets.

2.2.4.1 Locate intermediate distribution frames as indicated on the drawings.

2.2.5 Backbone Cabling: Cabling, pathways, and terminal hardware connecting intermediate distribution frames (IDF's) with main distribution frame (MDF), wired in star topology with main distribution frame at center hub of star.

2.2.6 Cabling to Outlets: Specified horizontal cabling, wired in star topology to distribution frame located at center hub of star; also referred to as "links".

2.3 PATHWAYS

2.3.1 Conduit: As specified in Section 26 05 34; provide pull cords in all conduit.

2.3.2 Underground Service Entrance: PVC, Type EPC-40 conduit.

2.4 COPPER CABLE AND TERMINATIONS

2.4.1 Copper Backbone Cable: TIA/EIA-568 Category 6 solid conductor unshielded twisted pair (UTP), 24 AWG, 100 ohm; 100 pairs formed into 25-pair binder groups; covered with gray thermoplastic jacket and complying with all relevant parts of and addenda to latest editions of TIA/EIA-568 and ICEA S-90-661, and UL 444.

2.4.1.1 In locations other than in plenums, provide NFPA 70 type CMR riser-rated or type CMP plenum-rated cable.

2.4.1.2 In plenums, provide NFPA 70 type CMP plenum-rated cable.

2.4.1.3 Provide cable having conductors twisted at minimum rate of two per foot; actual length and frequency of twists at manufacturer's option.

2.4.1.4 Color code conductors in accordance with ICEA S-90-661.

2.4.1.5 Testing: Furnish factory reel tests.

2.4.2 Copper Horizontal Cable: TIA/EIA-568 Category 6 solid conductor unshielded twisted pair (UTP), 24 AWG, 100 ohm; 4 individually twisted pairs; covered with blue jacket and complying with all relevant parts of and addenda to latest edition of TIA/EIA-568 and UL 444.

2.4.2.1 In locations other than in plenums, provide NFPA 70 type CMG general purpose, CMR riser-rated, or type CMP plenum-rated cable.

2.4.2.2 In plenums, provide NFPA 70 type CMP plenum-rated cable.

2.4.2.3 Testing: Furnish factory reel tests.

2.4.3 Copper Cable Terminations: Insulation displacement connection (IDC) type using appropriate tool; use screw connections only where specifically indicated.

2.4.4 Jacks and Connectors: RJ-45, non-keyed, terminated with 110-style insulation displacement connectors; high impact thermoplastic housing; complying with same standard as specified horizontal cable and UL 1863.

2.4.4.1 Performance: 500 mating cycles.

2.4.4.2 Voice and Data Jacks: 4-pair, pre-wired to T568A configuration, with color-coded indications for T568B configuration.

2.5 FIBER OPTIC CABLE AND ADAPTORS

2.5.1 Fiber Optic Backbone Cable: 24-fiber, single mode 50/125 um, complying with TIA- 492AAAB; covered with orange cable jacket and complying with relevant portions of and addenda to latest edition of TIA/EIA-568.

2.5.1.1 In locations other than in plenums, provide NFPA 70 type OFNR nonconductive- riser-rated or type OFNP nonconductive-plenum-rated cable.

2.5.1.2 In plenums, provide NFPA 70 type OFNP nonconductive-plenum-rated cable.

2.5.1.3 Testing: Furnish factory reel tests.

2.5.2 Fiber Optic Horizontal Cable: Two-fiber, single mode 50/125 um, complying with TIA- 492AAAB; covered with orange single jacket and complying with relevant portions of and addenda to latest edition of TIA/EIA-568.

2.5.2.1 In locations other than in plenums, provide NFPA 70 type OFN nonconductive general purpose, OFNR nonconductive-riser-rated, or type OFNP nonconductive- plenum-rated cable.

2.5.2.2 In plenums, provide NFPA 70 type OFNP nonconductive-plenum-rated cable.

2.5.2.3 Testing: Furnish factory reel tests.

2.5.3 Fiber Optic Adapters and Connectors: LC/LC Single mode, push-on-push-off, type, single adaptors with zirconia ceramic alignment sleeves; complying with relevant parts and addenda to latest edition of TIA/EIA-568 and with maximum attenuation of 0.3 dB at 1300 nm with less than 0.2 dB change after 500 mating cycles when tested in accordance with TIA-455-21.

2.6 CROSS-CONNECTION EQUIPMENT

2.6.1 Connector Blocks for Category 5e and Up Cabling: Type 110 insulation displacement connectors; capacity sufficient for cables to be terminated plus 25 percent spare.

2.6.2 Patch Panels for Copper Cabling: Sized to fit EIA standard 19 inch wide equipment racks; 0.09 inch thick aluminum; cabling terminated on Type 11O insulation displacement connectors; printed circuit board interface.

2.6.2.1 Jacks: Non-keyed RJ-45, suitable for and complying with same standard as cable to be terminated; maximum 48 ports per standard width panel.

2.6.2.2 Capacity: Provide ports sufficient for cables to be terminated plus 25 percent spare.

2.6.2.3 Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA/EIA-606 using encoded identifiers.

2.6.2.4 Provide incoming cable strain relief and routing guides on back of panel.

2.6.2.5 Patch Cords: Provide one (1) patch cord for each pair of patch panel ports.

2.6.3 Patch Panels for Fiber Optic Cabling: Sized to fit EIA standard 19 inch wide equipment racks; 0.09 inch thick aluminum.

2.6.3.1 Adaptors: As specified above under FIBER OPTIC CABLING; maximum of 24 duplex adaptors per standard panel width.

2.6.3.2 Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA/EIA-606 using encoded identifiers.

2.6.3.3 Provide incoming cable strain relief and routing guides on back of panel.

2.6.3.4 Provide rear cable management tray at least 8 inches deep with removable cover.

2.6.3.5 Provide dust covers for unused adaptors.

2.6.3.6 Patch Cords: Provide one (1) patch cord for each pair of patch panel ports.

2.7 ENCLOSURES

2.7.1 Backboards: Interior grade plywood without voids, 3/4 inch thick; UL-labeled fire- retardant.

2.7.1.1 Size: As indicated on drawings.

2.7.1.2 Do not paint over UL label.

2.7.2 Equipment Racks and Cabinets: 7 ft DAMAC CEA-310 standard 19 inch wide component racks.

2.7.2.1 Floor Mounted Racks: 16 gage steel construction with corrosion resistant finish; vertical and horizontal cable management channels, top and bottom cable trou1 hs, and grounding lug.

2.7.3 Building Entrance Protector: Factory fabricated panel to connect incoming cable and interior cable to protector modules.

2.7.3.1 Capacity: One protector module per pair in incoming cable.

2.7.3.2 Protector Modules: Type rated for the application.

2.7.3.2.1 Solid State Type: Complying with UL 497.

2.7.3.3 Incoming Side: Provide cable stub of same type as backbone cabling factory connected to protector module socket blocks.

2.7.3.4 Outgoing Side (to Interior): Backbone cable wired to connector blocks.

2.7.4 Outlet Boxes: For flush mounting in walls; depth as required to accommodate cable manufacturers recommended minimum conductor bend radius.

2.7.4.1 Size, Unless Otherwise Indicated: 4 inches square by 2-1/8 inches deep.

2.7.4.2 Wall-Mounted Telephones: 4 inches high by 2 inches wide by 2-1/8 inches deep.

2.7.4.3 Boxes for Fiber Optic Outlets: Single or two gang as indicated.

2.7.4.3.1 Size: 4-11/16 inches square by 2-1/8 inches deep.

2.7.4.4 Faceplates: High impact thermoplastic, complying with system design standards and UL 514C.

2.7.4.5 Labels: Comply with TIA/EIA-606 using encoded identifiers; label each jack on the face plate as to its function with a unique numerical identifier.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

3.1.1 Comply with latest editions and addenda of TIA/EIA-568, TIA/EIA-569, ANSI/J-STD- 607, NFPA 70, and SYSTEM DESIGN as specified in PART 2.

3.1.2 Comply with latest editions and addenda of TIA-570, ANSI/J-STD-607, NFPA 70, and SYSTEM DESIGN as specified in PART 2.

3.2 PATHWAYS

3.2.1 Underground Service Entrance: Install conduit at least 18 inches below finish grade; encase in at least 3 inches thick concrete for at least 60 inches out from the building line.

3.2.2 Install with the following minimum clearances:

3.2.2.1 48 inches from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.

3.2.2.2 12 inches from power conduits and cables and panelboards.

3.2.2.3 5 inches from fluorescent and high frequency lighting fixtures.

3.2.2.4 6 inches from flues, hot water pipes, and steam pipes.

3.2.3 Conduit:

3.2.3.1 Do not install more than 2 (two) 90 degree bends in a single horizontal cable run.

3.2.3.2 Leave pull cords in place where cables are not initially installed.

3.2.3.3 Conceal conduit under floor slabs and within finished walls, ceilings, and floors except where specifically indicated to be exposed.

3.2.3.3.1 Conduit may remain exposed to view in mechanical rooms, electrical rooms, and telecommunications rooms.

3.2.3.3.2 Treat conduit in crawl spaces and under floor slabs as if exposed to view.

3.2.3.3.3 Where exposed to view, install parallel with or at right angles to ceilings, walls, and structural members.

3.2.3.3.4 Under floor slabs, locate conduit at 12 inches, minimum, below vapor retarder; seal penetrations of vapor retarder around conduit.

3.2.4 Outlet Boxes:

3.2.4.1 Coordinate locations of outlet boxes provided under Section 260537 as required for installation of telecommunications outlets provided under this section.

3.2.4.1.1 Mounting Heights: Unless otherwise indicated, as follows:

3.2.4.1.1.1 Telephone and Data Outlets: 18 inches above finished floor.

3.2.4.1.1.2 Telephone Outlets for Side-Reach Wall-Mounted Telephones: 54 inches above finished floor to top of telephone.

3.2.4.1.1.3 Telephone Outlets for Forward-Reach Wall-Mounted Telephones: 48 inches above finished floor to top of telephone.

3.2.4.1.2 Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.

3.2.4.1.3 Provide minimum of 24 inches horizontal separation between flush mounted outlet boxes installed on opposite sides of fire rated walls.

3.2.4.1.4 Unless otherwise indicated, provide separate outlet boxes for line voltage and low voltage devices.

3.2.4.1.5 Locate outlet boxes so that wall plate does not span different building finishes.

3.2.4.1.6 Locate outlet boxes so that wall plate does not cross masonry joints.

3.2.5 Grounding and Bonding: Perform in accordance with ANSI/J-STD-607 and NFPA 70.

3.2.6 Firestopping: Seal openings around pathway penetrations through fire-rated walls, partitions, floors, and ceilings in accordance with Section 078400.

3.3 INSTALLATION OF EQUIPMENT AND CABLING

3.3.1 Cabling:

3.3.1.1 Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.

3.3.1.2 Do not over-cinch or crush cables.

3.3.1.3 Do not exceed manufacturer's recommended cable pull tension.

3.3.1.4 When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.

3.3.2 Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:

3.3.2.1 At Distribution Frames: 120 inches.

3.3.2.2 At Outlets - Copper: 12 inches.

3.3.2.3 At Outlets - Optical Fiber: 39 inches.

3.3.3 Copper Cabling:

3.3.3.1 Category 5e/6: Maintain cable geometry; do not untwist more than 1/2 inch from point of termination.

3.3.3.2 For 4-pair cables in conduit, do not exceed 25 pounds pull tension.

3.3.3.3 Copper Cabling Not in Conduit: Use only type CMP plenum-rated cable as specified.

3.3.4 Fiber Optic Cabling:

3.3.4.1 Prepare for pulling by cutting outer jacket for 10 inches from end, leaving strength members exposed. Twist strength members together and attach to pulling eye.

3.3.4.2 Support vertical cable at intervals as recommended by manufacturer

3.3.4.3 Free-air will be ran in inner duct 1 ¼ inch.

3.3.5 Floor-Mounted Racks and Enclosures: Permanently anchor to floor in accordance with manufacturer's recommendations.

3.3.6 Field-Installed Labels: Comply with TIA/EIA-606 using encoded identifiers.

3.3.6.1 Cables: Install color coded labels on both ends.

3.3.6.2 Outlets: Label each jack on its face plate as to its type and function, with a unique numerical identifier.

3.3.6.3 Patch Panels: Label each jack as to its type and function, with a unique numerical identifier.

3.3.6.3.1 Patch Cords: Label with jack identifier corresponding to initial installation.

3.4 FIELD QUALITY CONTROL

3.4.1 Comply with inspection and testing requirements of specified installation standards.

3.4.2 Visual Inspection:

3.4.2.1 Inspect cable jackets for certification markings.

3.4.2.2 Inspect cable terminations for color coded labels of proper type.

3.4.2.3 Inspect outlet plates and patch panels for complete labels.

3.4.2.4 Inspect patch cords for complete labels.

3.4.3 Testing - Copper Cabling and Associated Equipment:

3.4.3.1 Test backbone cables after termination but before cross-connection.

3.4.3.2 Test backbone cables for DC loop resistance, shorts, opens, intermittent faults, and polarity between connectors and between conductors and shield, if cable has overall shield.

3.4.3.3 Test operation of shorting bars in connection blocks.

3.4.3.4 Category 5e/6 Backbone: Perform near end cross talk (NEXT) and attenuation tests.

3.4.3.5 Category 5e/6 Links: Perform tests for wire map, length, attenuation, NEXT, and propagation delay.

3.4.4 Testing - Fiber Optic Cabling:

3.4.4.1 Backbone: Perform optical fiber end-to-end attenuation test using an optical time domain reflectometer (OTDR) and manufacturer's recommended test procedures; perform verification acceptance tests and factory reel tests.

3.4.4.2 Single Backbone: Perform tests in accordance with TIA/EIA-526-14 Method B.

3.4.4.3 Links: Perform optical fiber end-to-end attenuation tests and field reel tests.

3.4.5 Final Testing: After all work is complete, including installation of telecommunications outlets, and telephone dial tone service is active, test each voice jack for dial tone.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

1.1.1 Furnish and install a complete data communications system. The system shall consist of but not limited to cables (fiber optic and category-rated twisted-pair copper), innerduct, patch panels, fiber interconnect equipment, wire managers, cable supports, connectors (fiber and copper), wiring blocks and telecommunications outlets, patch cords and any other equipment and accessories as required. The work performed under this specification shall be of good quality and performed in a workmanlike manner. In this context "good quality" means the work shall meet industry technical standards, best practices and quality of appearance. The Owner reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.

1.1.2 All fiber strands shall be terminated with connectors and landed on the fiber interconnect equipment. All copper station cables shall be terminated on patch panels (IDF/MDF end) and data communications outlets (work station end).

1.1.3 The copper cabling system shall perform to Category-6 Permanent Link performance requirements, from patch panel to outlet jack. The system shall be capable for transmission of the Gigabit Ethernet (1000Base-T) protocol and other designed for Category-6 cabling systems.

1.2 RELATED DOCUMENTS

1.2.1 Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to work specified in this Section.

1.2.2 Sections 26 00 00, 26 05 00, 27 05 50.

1.2.3 Applicable Standards:

1.2.3.1 ANSI/TIA-492.AAAC-B – Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers

1.2.3.2 ANSI/TIA-492.AAAD – Detail Specification for 850-nm Laser- Optimized, 50-µm Core Diameter/125-µm Cladding Diameter Class la Graded-Index Multimode Optical Fibers Suitable for Manufacturing OM4 Cabled Optical Fiber

1.2.3.3 ANSI/TIA-492.CAAB – Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak. Current Edition

1.2.3.4 ANSI/TIA-568.0-D – Generic Communications Cabling for Customer Premises

1.2.3.5 ANSI/TIA-568.1-D – Commercial Building Communications Cabling Standard

1.2.3.6 ANSI/TIA-568-C.2-1 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards

1.2.3.7 ANSI/TIA-568.3-D – Optical Fiber Cabling and Components Standard

1.2.3.8 ANSI/TIA-569-D – Telecommunications Pathways and Spaces

1.2.3.9 ANSI/TIA-606-B.1 – Administration Standard for the Commercial Telecommunications Infrastructure.

1.2.3.10 ANSI/TIA-607-C – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

1.2.3.11 ANSI/TIA-862-B – Structured Cabling Infrastructure Standard for Intelligent Building Systems

1.2.3.12 ANSI/TIA-942-A – Telecommunications Infrastructure Standard for Data Centers

1.2.3.13 NFPA 70 – National Electrical Code (NEC).

1.2.3.14 BICSI – TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM)

1.3 CONTRACTOR QUALIFICATIONS

In order to qualify for installation of the data communications system, Contractor must possess the required license classification, a performance history, experience in the installation and termination of fiber optics cable systems, certification from cabling manufacturer, and proof of time in business.

1.3.1 License Classification: Contractor must possess a valid C-7 California State Contractor's License. This license must have been issued two (2) years prior to the date of this bid. No other license classification is acceptable.

1.3.2 Performance History: Contractor must have successfully performed at least three (3) projects of similar scope, within two (2) years of the date of this bid. Proof of performance shall be in the form of reference sheets which shall include a brief description of the project, the beginning and ending contract price, the project foreman or superintendent's name, and the name, address, and telephone number of a project contact.

1.3.3 Fiber Optics Experience: Contractor must be able to prove to the satisfaction of Owner that it has significant experience in the installation of fiber optics cable systems. Installation must include installation of fiber optics cable, fiber termination, a knowledge of interconnect equipment, and a thorough knowledge of testing procedures. Contractor must provide a minimum of three (3) references supporting its claim of experience for similar projects within the two

(2) years prior to this bid. Documentation must be included with the bid documents submitted.

1.3.4 Certification from Cabling Manufacturer: Contractor must be able to prove to the satisfaction of the Owner via a certificate that certification in copper and fiber optic product installation has been granted and is current, and that the Contractor is able to extend the full manufacturer's warranty to the cable system installation.

1.3.5 Time in Business: Contractor must have been in business and in the business of installing telecommunications systems, continuously, for a period of at least three (3) years, prior to the date of this bid. Contractor must submit at least one (1) project reference for each of the three (3) years prior to the date of this bid. These project references shall contain the same information required in Paragraph B above. Contractor must also provide a list of key installation personnel, their hire dates, and a resume of their experience. Key installation personnel shall include at least one (1) foreman and two (2) journey level installers or technicians. By submitting the names of these personnel, Contractor is committing them to the execution of the project as outlined in this specification.

1.4 DEFINITIONS

1.4.1 Main Distribution Facility (MDF): The MDF is the location, within a building or complex of buildings, where the entire telecommunications system originates. It may include: The physical location, enclosure, wire and cable management hardware, termination hardware, distribution hardware, and equipment racks. ANSI/TIA-569 refers to the room housing the MDF as the "Equipment Room" or ER. These terms are interchangeable.

1.4.2 Intermediate Distribution Facility (IDF): The IDF is the location in a building where a transition between the backbone or vertical riser system and the horizontal distribution system occurs. It may include: The physical location, enclosure, wire and cable management hardware, termination hardware, distribution hardware, and equipment racks. The IDFs provide the interface location between fiber distribution cable (backbone) and station cable (horizontal distribution). ANSI/TIA-569 refers to the room housing the IDF as the "Telecom Room" or TR. A "Telecom Enclosure" (TE) is an IDF which consists solely of an equipment cabinet outside a dedicated telecom room.

1.4.3 Backbone Pathway: The Backbone Pathway consists of a series of conduits, cable trays or chases which connect the MDF to IDFs or IDFs to IDFs. It generally houses the vertical or backbone system.

1.4.4 Backboard: Backboard generally refers to the plywood sheeting lining the walls of telecommunications facilities. Backboard may also refer to the entire wall-mounted assembly, including wire management, wiring blocks, and equipment racks. In this case, the term Backboard is fully interchangeable with SBB or TTB and the equipment required to fulfill the Scope of Work below. Backboard must be fire rated and stamped; painted black with fire proof paint.

1.5 SYSTEM DESCRIPTION

1.5.1 The data communications system shall consist of active network switch equipment, a fiber optics backbone and twisted pair copper work station cabling. The central location shall house an MDF and each of the other locations shall house an IDF. Each fiber optics cable shall originate in the MDF and shall be terminated in its respective IDF. All fiber optics cables shall be enclosed in innerduct which shall be routed through a system of conduits and raceways. From each IDF one or more twisted-pair copper cables shall be routed to each data outlet location. These cables shall originate in an IDF and terminate in its respective data outlet location. The MDF and each IDF will house active data distribution equipment including but not limited to fiber switches, data terminal controllers, local area network switches, data storage devices, fiber optic transceivers, network routers, and DSU/CSU devices. Unless specifically noted, active equipment is not within the scope of the work.

1.6 MANUFACTURER

1.6.1 Throughout this specification, manufacturers are cited, along with specific part numbers. These citations are for the purpose of establishing quality and performance criteria.

1.6.2 Wherever possible, components of and end-to-end solution manufacturer or consortium shall be used in order to obtain the full manufacturer warranty for that cable system.

1.6.3 Manufacturer’s warranty shall extend to the usable lifetime of the cable plant. Lesser warranties from date of installation shall be at Owner’s discretion.

1.7 SUBMITTALS AND SUBSTITUTIONS

1.7.1 The submission shall consist of five (5) major sections with each section separated with insertable index tabs.

1.7.1.1 The first section shall be the "Index" which shall include the project title and address, name of the firm submitting the proposal and name of the Architect. Each page in the submission shall be numbered chronologically and shall be summarized in the index.

1.7.1.2 The second section shall include a copy of the Contractor's valid C-7 California State Contractor's License, the information required in Section 1.2 above, and a list of instrumentation to be used for system testing.

1.7.1.3 The third section shall contain a table of contents with product literature including cut sheets and specification sheets.

1.7.1.4 The fourth section shall contain samples of proposed cable markers and labeling.

1.7.1.5 The fifth section shall contain a complete set of shop drawings, point-to-point wiring, non-contiguous cable routes (“J-hook pathways”), device/outlet locations, rack elevation showing all major equipment such as patch panels and fiber interconnect equipment, detailed satellite closet count, and bill-of-materials.

1.7.2 For purposes of determining equality, technical and general information set forth on the respective data sheets by manufacturers named for each specified item shall be considered as part of these specifications and binding herein. Any proposed equal item offered shall be substantiated fully to prove equality. The Owner reserves the right to require a complete sample of any proposed equal item and may, if necessary, request a sample tested by and a copy of the test results by an independent testing laboratory to prove equality. The decision of the Owner regarding equality of proposed equal items will be final.

1.8 FUNCTION AND OPERATION

1.8.1 The intended function of the data communications cable system is to transmit data signals from a central location to several individual data outlet locations.

1.8.2 The multimode fiber optics cable system shall be capable of transmitting signals with a bandwidth per the performance parameters of the specified cable. The cumulative signal loss, through connectors, jumpers, couplers, and fiber cable, shall be no more than the manufacturer's stated dB loss based on cable length and 0.5 dB loss for each mated connector pair.

1.8.3 Work station cable, commencing at the wiring blocks, shall be installed in accordance with the ANSI/TIA-568 standard and shall be capable of transmitting a signal at 1 Gbps (1 Gigabit) with acceptable performance in accordance with Category-6 performance requirements as specified in ANSI/TIA-568. The entire work station cable system, including wiring blocks, cable, and telecommunications outlets shall be tested for Category-6 compliance.

PART 2 - PRODUCT AND INSTALLATION

2.1 GENERAL

2.1.1 Equipment shall be installed in accordance with the drawings and the manufacturer's requirements. General installation provisions are as follows:

2.1.1.1 Equipment Racks: Each rack shall be mounted such that the side rails are plumb. Each wall-mounted rack shall be affixed to the backboard at each of the mounting holes provided. Attachment shall be by ½ inch x 1-1/4 inch lag bolts. A 3/8 inch pilot hole shall be drilled for each lag bolt. Free-standing equipment racks shall be secured to the floor with ½ inch lag bolts (wood floor) as above, or ½ inch x 3-3/4 inch (min) concrete wedge anchors (concrete floors) via the mounting holes provided.

2.1.1.2 Wiring Blocks and Wire Management Components: Where required, wiring blocks and wire management components shall be mounted to the plywood backboard. Each device shall be mounted such that its horizontal dimension is level. In cases where more than one device is mounted, they shall be aligned vertically. Each device shall be affixed to the plywood backboard by means of screws suitable for fastening to plywood. A minimum of four (4) of the mounting holes provided shall be utilized for fastening.

2.1.1.3 Fiber and Copper Cable: Where fiber or copper cable enters an MDF or IDF it shall be routed along the backboard via "D" Rings and secured by cable ties in accordance with the attached drawings. All cable shall be neatly bundled, combed, and tied. All cable runs within the MDF or IDF shall be horizontal or vertical within the constraints of minimum cable bending radii. Radiused cable dropouts shall be used to maintain proper bend radius and cable geometry, and to relieve stress.

2.1.1.4 Fiber Optics Interconnect Equipment: Interconnect equipment may be mounted either on the plywood backboard or in the equipment racks, depending on the particular application and as noted on the drawings. When mounted on the backboard, the horizontal dimension shall be level. A minimum of four (4) of the mounting holes provided shall be utilized for fastening. Screws shall be tightened to the extent that they hold the device snug to the backboard, but not so tight as to distort or damage the device. Interconnect equipment mounted in racks shall be affixed to the rack by at least four (4) screws. The screws shall be of the correct size and thread configuration for the holes in the rack.

2.1.1.5 General Labeling: With exception of work station cables behind termination hardware, hand written labels are not acceptable. All visible labels shall be machine printed on clear or opaque tape, stenciled onto adhesive labels, or type written onto durable adhesive labels. The font shall be at least 1/8 inch in height, block characters, and legible. The text shall be of a color contrasting with the label such that it may be easily read (example: white text on black tape, or vice versa). If labeling tape is utilized, the font color shall contrast with the background. Patch panels shall exhibit workstation numbers, in sequential order, for all workstations served by the MDF or IDF. District will provide example, if needed.

2.1.1.6 Each fiber optics cable segment shall be labeled at each end with its respective IDF identifier. Each fiber interconnect device shall be labeled with its respective IDF identifier. Each telecommunications outlet shall be labeled with its respective work station number (machine labels only). Workstation numbers shall be comprised of the Building Designator-The Room Number-The Station Number (for example A-205-2). Each workstation cable shall be neatly hand labeled, using permanent ink or other permanent labeling medium, at each end with its respective workstation number. Each copper backbone cable shall be machine labeled at each end with its respective IDF number. Each binder group shall be tied off with its respective identifying ribbon at each break-out point.

For device floor boxes, the label shall be inside the box either on the back of the lid cover or adjacent to the device.

2.1.1.7 Warning Tags: At each location where the fiber cable is exposed to human intrusion, it shall be marked with warning tags. These tags shall be yellow or orange in color, and shall contain the warning: "CAUTION FIBER OPTIC CABLE". The text shall be permanent, black, block characters, and at least 3/16 inch high. A warning tag shall be permanently affixed to each exposed cable or bundle of cables, at intervals of not less than 5 feet. Any section of exposed cable which is less than 5 feet in length shall have at least one warning tag affixed to it. Cables shall be tagged in pull boxes and at all locations not in conduit.

2.2 FIBER INNERDUCT

2.2.1 Description: From the MDF to each IDF segments of fiber optics innerduct shall be installed in the conduit system.

2.2.1.1 Product: Carlon or equal, minimum 1.25 inch OSP fiber optic cable innerduct, orange, corrugated, routed in conduit, with all necessary accessories.

2.2.1.2 Quantities Required: Innerduct runs do not have to be continuous throughout, breaks are expected at the pull boxes (only). Contractor is responsible for determination of actual lengths of innerduct required. Enough innerduct shall be provided and installed to extend from the fiber service loop in the MDF to the fiber service loop in each IDF. If the route passes through a pull box, the segments of innerduct shall extend 12 inches into the pull box. If the route passes through an enroute IDF, each segment of innerduct shall extend at least 12 inches beyond the end of the service conduit.

2.2.1.3 Installation: Fiber innerduct shall be installed in accordance with manufacturer’s instructions and industry standards. Within the equipment rooms, the innerduct shall extend from the end of conduit to 4 feet above the floor and shall be affixed to the backboard by means of clamps designed for that purpose. Care shall be taken to avoid kinking the innerduct or applying excessive tension during the installation process.

2.3 FIBER DISTRIBUTION

2.3.1 Description: From the MDF to each IDF a continuous segment of fiber cable shall be installed. Routing shall be via conduit in accordance with electrical site drawings. Through each conduit section, the cable shall be housed in a 1-1/4 inch innerduct, care being taken not to exceed NEC specifications regarding conduit fill. The cable shall be suitable for subsurface installation if routed outdoors or in/under ground level concrete. Outside Plant cable shall not extend more than 50 feet into the building interior unless enclosed in conduit.

2.3.2 Fiber Optic Cables:

2.3.2.1 Singlemode (SM) Fiber Parameters:

2.3.2.1.1 9/125/250 micron.

2.3.2.1.2 Maximum attenuation dB/km at 1310/1550 nm: 0.40/0.30. (0.7/0.7 for distribution cable)

2.3.2.1.3 Gigabit Ethernet distance guaranteed to 10,000 meters.

2.3.2.2 Site Cable Parameters:

2.3.2.2.1 Strength Member: Aramid.

2.3.2.2.2 Outside plant cable rated.

2.3.2.2.3 Cable shall be non-conductive per CEC 775-4

2.3.2.2.4 Loose tube construction.

Fiber cables shall be Superior Essex Dry Block Sunlight Resistant Indoor/Outdoor Plenum, Berk-Tek OPD series Outside Plant Loose Tube, Corning ALTOS All-Dielectric Loose Tube Cables, or **equal**. Strand count as indicated on plans (Provide 12-strand SM cables where no strand count indicated). Cable construction shall consist of a central dielectric strength member, fiber in loose buffer tubes, surrounded by water blocking material, rip cord, dielectric strength member all around and a PE outer jacket.

2.3.2.3 Building Cable Parameters:

2.3.2.3.1 Tight buffered non-conductive.

2.3.2.3.2 Indoor/outdoor OFNR or OFNP rated.

2.3.2.3.3 Utilizes 900 micron tight buffered fibers.

Fiber cables shall be Superior Essex Dry Block Sunlight Resistant Indoor/Outdoor Plenum, Berk-Tek Premises Distribution Indoor/Outdoor cable, Corning FREEDM One Unitized Cables, or equal. Strand count as indicated on plans (Provide 12-strand SM cables where no strand count indicated).

2.3.2.3.4 Singlemode cables shall be terminated. Provide 15 ft. of excess cable at IDF/MDF bundled in tight loop. Store in Leviton 48900-IFR (12 inch) or 48900-OFR (24 inch) fiber wall storage loop.

2.3.3 Fiber connectors

2.3.3.1 Pre-polished fiber optic connectors shall be the primary means of field-terminating individual fiber strands at the enclosure or faceplate location, to eliminate the need for hand polishing, bonding, or epoxy in the field.

2.3.3.2 Shall meet or exceed the requirements described in TIA-568 and ANSI/TIA-604-10 (LC) Connector Intermateablity Standards

2.3.3.3 Shall utilize a precision zirconia ceramic ferrule, and be re-terminable up to 3 times during testing without loss of performance.

2.3.3.4 Shall require the use of a cleaver with a guaranteed maximum cleaving angle of 1 degree for singlemode fibers. No permanent crimp or crimping tool shall be used.

2.3.3.5 Shall be provided in LC for both single-mode and multimode (laser optimized) configurations, terminated on 250 or 900 micron buffered fiber and/or 2mm or 3 mm jacketed fiber.

2.3.3.6 Maximum connector insertion loss shall be no greater than 0.5 dB, with an average of 0.1 dB (MM) or 0.2dB (SM). Typical connector return loss shall be 35 dB (multimode) and 56 dB (single mode). All versions shall allow continuity to be verified by use of a visual fault locator (VFL). Fiber connectors shall be Ortronics OR205KAN9GA5M-LC, or equal.

2.3.4 Fan-Out Kits: For termination of loose tube fiber cables. For buffer tube sizes of 2.0mm to 3.5mm, Ortronics OR-61500858. Provide fan-out kits for terminating all loose-tube fibers.

2.3.5 Installation: Installation shall be conducted following guidelines established by the product manufacturer and industry standards.

2.3.5.1 Fiber Optic Cable: During installation of the fiber optic cable segments into the conduit system, special care shall be taken to avoid damage to the cable. While under pulling tension, the cable shall not be bent into a curve with a radius of less than 20 times the cable diameter. Pulling tension shall not exceed manufacturer's recommended maximum tensile load. Contractor shall pull cables by hand or utilize a cable winch (aka “tugger”) with tension control "break- away" link designed to break away at or below the recommended maximum tension. The fiber optic cable shall be routed through the conduit and onto the appropriate IDF backboard. Routing on the backboard shall be straight and plumb.

2.4 WORK STATION CABLE AND JACKS

2.4.1 Description: From each IDF and MDF, provide data cable(s) to each work station (data outlets) served.

2.4.1.1 Product: 4 pair 23 AWG UTP, Category-6 cable, third party verified to exceed all Superior Essex CMR 77-246-3A ANSI/TIA-568 parameters. Superior Essex CMR 77-246-3A, or equal, CMR rated (minimum). Cables routed in or through air plenums shall be Superior Essex CMP 77-246-3B rated with same performance parameters. Shall be able to support 10/100/1000 MBPS (up to 1Gbps).

2.4.1.2 Guaranteed performance at 250Mhz:

2.4.1.2.1 Attenuation (IL) = 32.6 dB max.

2.4.1.2.2 NEXT = 43.3 dB min.

2.4.1.2.3 ACR = 10.8 dB min.

2.4.1.2.4 PS NEXT = 41.3 dB min.

2.4.1.2.5 PS ACR = 24.8 dB min.

2.4.1.2.6 ELFEXT (ACRF) = 20.8 dB min.

2.4.1.2.7 PS ELFEXT (PSACRF) = 21.8 dB min.

2.4.1.2.8 Return Loss = 20.5 dB min.

2.4.1.3 Required Accessories and Quantities (Hard Wall Locations):

2.4.1.3.1 Wall Plate: Ortronics Tech Choice wallplates Number OR-KSFP2-99 or OR-KSFP4-99 2-port or 4-port (single gang and multi-gang), with designation windows, with blank fillers.

2.4.1.3.2 Category-6 Jacks: Ortronics OR-KS6-13.

2.4.1.3.3 Miscellaneous: Provide appropriate modules with appropriate connectors for other system devices such as: OR-63700006, OR-KSBNC75, OR-KSB10-13 etc.

2.4.1.4 At other than wall installations (i.e., raceways, floor boxes, etc.) provide Ortronics Category-6 jacks to fit application.

2.4.2 Installation: Installation shall be conducted in accordance with guidelines established by the product manufacturer and industry standards. Wall plates shall be mounted such that their vertical dimension is plumb. Each wall plate shall be labeled with its respective work station number. Each modular mounting frame shall be labeled with its respective work station number. Wallplates adjacent to electrical and other wallplates shall be at the same elevation above finished floor UON.

2.5 INTERMEDIATE DISTRIBUTION FACILITIES (IDF)

2.5.1 Description: In situations where the cable route distance to the furthest workstation in the building is greater than 100 meters, additional IDFs shall be constructed. Where closet space is available, each IDF shall utilize wall racks. Where closet space is not available, the IDF shall be in a cabinet.

2.5.1.1 Products and Quantities:

2.5.1.1.1 Data Cabinets (19 inch W): Chatsworth Cube – K plus cabinet system with lockable front door. Height shall be as follows:

25 to 72 ports = 36 inch H (18U, 200 lbs capacity)

61 to 96 ports = 48 inch H (26U, 200 lbs capacity)

Provide as many cabinets as needed in increments as indicated above.

2.5.1.1.2 Fiber Interconnect: Ortronics rack mount fiber cabinet (OptiMo FC Series) multi-port with number of ports as required, 16-gauge steel construction, wall mounted with split-hinged key door for separate fiber jumper access. Provide with fiber adapters for each strand. Provide minimum 12 spare ports.

2.5.1.1.3 Modular Patch Panels: Rack mounted. Ortronics ORSPKSU48 48 port keystone patch panel with ORKS613 Ivory Jacks or KS645 Green Jacks for access points, T568B configuration, in 48 port increments. One (1) port for each workstation served with a minimum of 12 spare ports are required. Minimum (1) 24 port patch panel. Provide as many patch panels as necessary to service all workstation cables plus the required spare count.

2.5.1.1.4 Wiring Blocks: Ortronics OR-30200145 110 type blocks.

2.5.1.2 Required Accessories and Quantities:

2.5.1.2.1 Wire Management: Hellerman Tyten WMB2horizontal wire Manager; dual sided.

2.5.1.2.2 "D" Rings: Provide and install sufficient quantities of 2 inch and 3 inch "D" rings, at 12 inches on center on wall/backboard.

2.5.1.3 Provide a telecommunications grounding bus bar. Solid copper; ¼ inch thick; 10 inch W x 4 inch H with insulators and stand off brackets; with predrilled holes. Provide ½ inch - 1 No. 6 min. (green) ground to main building panel ground bus. Bond rack and cable runway to telecom bus bar with 1 No. 6 (green) ground. Utilize 2-hole compression lugs.

2.5.2 Installation: Installation shall be conducted in accordance with manufacturer's recommendations, industry standards, and this specification. Installation includes complete assembly and mounting of the fiber interconnect and copper panels and equipment, dressing the fiber and copper cables, termination of all strands, pairs, wires, cables and conductors; complete assembly and mounting of the equipment rack and cable tray, mounting of the wiring blocks, and grounding of all metals inside the telecom room or enclosure.

2.6 TESTING AND DOCUMENTATION

2.6.1 Testing: Contractor shall test each multimode and single mode fiber strand and every pair of each twisted-pair copper cable, including shield continuity (where applicable). The Owner reserves the right to have a representative present during all or a portion of the testing process. If the Owner elects to be present during testing, test results will only be acceptable when conducted in the presence of the Owner.

2.6.1.1 Fiber Optics Cable: Each fiber strand shall undergo bi-directional testing for signal strength. In addition, at least one (1) fiber of each cable shall be tested using an OTDR to verify length and continuity.

2.6.1.1.1 Test Equipment: Optical Loss (OLTS): Softing WireXpert 4500, Fluke Networks DTX CableAnalyzer with DTX-EFM2 and DTX-SFM2 modules, or equal. OTDR: Softing FiberXpert OTDR 5000, Fluke Networks OptiFiber Pro, or equal.

2.6.1.1.2 Tests: Multimode Bi-directional signal attenuation at 850 and 1300 nm. Singlemode bi- directional signal attenuation testing at 1310 and 1550 nm, only if required to be terminated.

2.6.1.1.3 Test Criteria: Signal loss of for each fiber shall not be more than the loss summation due to cable length and 0.5 dB loss per connection assembly (Connector-to-connector) or 0.25 dB loss per connector, and 0.10 dB loss for each splice. Identify actual loss based on testing and calculated loss on test form. The tested loss (TL) shall be lower than the calculated loss (CL). The owner reserves the right to have fiber cables replaced and retested if the TL exceeds the CL.

2.6.1.1.4 Test results shall be transmitted to the Owner in original tester format and PDF printouts of the same.

2.6.1.2 Workstation Cable: Each workstation cable shall be tested from the Jack Panel to the data outlet to ANSI/TIA-568 Category-6 performance standards.

2.6.1.2.1 Test Equipment: Softing WireXpert 4500, Fluke DTX CableAnalyzer, or equivalent. Must meet Level IIIe compliance or greater in accordance with ANSI/TIA-568.

2.6.1.2.2 Tests: Signal Attenuation, Noise, Near End Cross-talk (NEXT), ELFEXT, Power sum NEXT, ACR, Return Loss, Cable Length, Propagation Delay and Delay Skew.

2.6.1.2.3 Test Criteria: The system shall be tested to Category-6 compliance. The test path shall include workstation jacks, station cables, and jack panels (Permanent Link Configuration). If Channel Certification is used on any link, the tested patch cords must remain connected to the outlets they test. The Owner reserves the right to have cables replaced and retested if performance parameters are not met.

2.6.2 Documentation: Contractor shall provide documentation to include test results and as-built drawings.

2.6.2.1 Fiber Test Results: Furnish test results of the fiber testing. Hand written results are not acceptable. Copies of test results are not acceptable. Only original format, printed test results in PDF ad accompanied by original tester format files will be acceptable. Contractor to provide licensed copy of tester software with submitted test results.

2.6.1.2 Work Station Cable: The results of the work station cable tests shall be provided in the form of print-outs from the test equipment, in PDF, with accompanying tester format files and licensed reader software for the tester format.

2.6.1.3 As-Built Drawings: Provide reproducible vellum as-builts, full size indicating each outlet location and designation. Show IDF/MDF locations, cable pathways and cable designations terminated.

2.7 ACCEPTANCE

2.7.1 Acceptance of the Data Communications System, by Owner, shall be based on the results of testing, functionality, and the receipt of documentation. With regard to testing, all fiber segments and all workstation data cables must meet the criteria established. With regard to functionality, Contractor must demonstrate to Owner that specified data signals can be successfully transmitted, bi-directionally, from the MDF/IDF to and from some number of individual data outlets. The number of outlet locations to be tested shall be determined by Owner. With regard to documentation, all required documentation shall be submitted to Owner.

PART 3 – EXECUTION

3.1 DIVISION OF WORK

3.1.1 Contractor shall install the data communications system as described in the preceding. Installation shall result in a functional system. The Scope of Work includes:

3.1.1.1 All necessary conduit and raceway.

3.1.1.2 Necessary trenching, backfill, replacement of landscape material, repair of damage to utilities or structures, replacement of asphalt and base, and replacement or repair to concrete flat work incidental to conduit or raceway installation.

3.1.1.3 Provide and install all equipment.

3.1.1.4 Supply and install all material discussed in this specification.

3.1.1.5 Test and document system, upon completion.

3.1.1.6 Supply and install all material necessary, whether or not discussed in this specification, to result in a complete and functional system.

3.2 ADDITIONAL INFORMATION

3.2.1 Refer to other sections for the following Part 3 - Execution Information

3.2.1 General

3.2.2 Cable Pathways

3.2.3 Work Area Outlets

3.2.4 Installation Practices

3.2.5 Labeling

3.2.6 Firestopping

3.2.7 Sealing of Penetrations and Openings

3.2.8 Cable Supports

3.2.9 Cable Protection

3.2.10 Grounding

3.2.11 Documentation

3.2.12 Training

3.2.13 Cleaning

3.2.14 Project Closeout

3.3 CABLE HANDLING / CABLE MANAGEMENT

3.3.1 Proper cable handling is critical to maintaining the design integrity of high-performance cabling. Cable handling recommendations include:

3.3.1.1 Cable must be conditioned above 32 degrees F for 48 hours prior to installation.

3.3.1.2 Do not use excessive force when pulling cable. The maximum pull-force guideline for a 4-pair horizontal UTP should not exceed 110N (25lbf). Meeting this guideline avoids stretching conductors during installation and the associated transmission degradation.

3.3.1.3 The minimum bend radius for UTP should not exceed four (4) times the cable outside diameter (O.D.) The O.D. of Cat 6A 100 ohm, balanced UTP cable is .30 in. (4 x .3 = 1.2 in. bend radius).

3.3.1.4 The minimum bend radius for fiber should not exceed 10x the cable outside diameter.

3.3.1.5 Traditional combing and dressing (bundling) of Category 6 and 6A cabling for a combed appearance is required in all exposed locations.

3.3.1.6 In TR, use appropriate horizontal cable management for patch cords on front of patch panels. Also, use appropriate cable management bar(s) for support of terminated horizontal cable.

3.3.1.7 Do not use vinyl or plastic cable ties due to the potential for over-cinching of cable bundles which can alter the cable geometry and degrade the system cabling performance. Use only hook and loop (“Velcro”) fasteners for bundling of horizontal cables.

3.3.1.8 Store cable slack in an extended loop configuration to alleviate cable stress. Excessive cable slack in bundled loops or traditional ‘service loops’ to provide additional cable length in TR has been shown to degrade cabling performance and are not recommended.

3.4 SEPARATION OF DATA AND POWER CABLING

3.4.1 Design cable pathways to avoid potential sources of EMI. Avoid installing cable near sources of EMI (X-ray equipment, large motors/generators, electrical power cabling and transformers, Radio frequency (RF) sources and transmitters, lighting, copiers, etc.).

3.4.2 Physically separate power and data cabling according to relevant code and standard requirements when run in a common pathway.

3.4.2.1 Never run data and Class 1 power cabling in parallel closer than 2 inch.

3.4.2.2 Avoid crossing cables if possible. If necessary, always cross cables at 90 degrees.

3.4.2.3 Maintain a minimum of 5 inch separation between data cable and all ballast controlled lighting.

3.4.3 Minimum separation distances of telecommunications cabling from potential sources of EMI exceeding 5kVA:

3.4.3.1 24 inch away from Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways

3.4.3.2 12 inch away from Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway

3.4.3.3 6 inches away from Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway

3.4.3.4 47 inches away from Electrical motors and transformers

3.5 INSTALLATION OF STRUCTURED CABLING SYSTEM

3.5.1 PRE-INSTALLATION CONFERENCE

3.5.1.1 Schedule a conference a minimum of five (5) calendar days prior to beginning work of this section.

3.5.1.2 Agenda: Clarify questions related to work to be performed, scheduling, coordination, etc.

3.5.1.3 Attendance: Communications system installer, General Contractor, Owners Representatives and any additional parties affected by work of this section. Owner's Information Technology must be represented at a preconference meeting prior to scheduling of any work.

3.5.1.4 Copy of Leviton warranty application will be provided by Contractor.

3.5.1.5 Pre-Installation conference may be waived only by Owner.

3.5.2 WARRANTY

3.5.2.1 A lifetime performance warranty covering all components, equipment and workmanship shall be submitted in writing with system documentation. The warranty period shall begin on the system's first use by the Owner.

3.5.2.2 The project must be pre-registered with Leviton (or pre-approved manufacturer) by the installation contractor before installation has begun, and shall be concluded by Contractor with uploading of test results to Leviton and a full project closeout. Warranty paperwork will be delivered directly from Leviton to the Owner.

3.5.2.3 Should the cabling system fail to perform within its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the Contractor shall promptly make all required corrections without cost to Owner.

3.5.3 DRAWINGS AND SPECIFICATIONS

3.5.3.1 The Contract drawings and specifications form an integral part of the contract documents. Neither the drawings nor the specifications shall be used alone. Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work. Work omitted from the drawings but mentioned or reasonably implied in the specifications, or vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirements on drawings, or specifications shall not relieve the Contractor of his or her responsibility of properly completing the Contract.

3.5.3.2 The Owner's Project Manager has the option of changing the location of Electrical and Communication outlets to within 3 meters of designed location prior to rough-in stage at no extra cost to Owner. Owner and Owner's Representative requests a chalk/rough-in walk prior to installation to verify locations.

3.5.3.3 The Contractor is responsible to take field measurements where equipment and material dimensions are dependent upon building dimensions and to coordinate and provide a chalk/rough-in walk prior to installation to verify locations.

3.5.3.4 The Contractor shall coordinate with General, Mechanical and Electrical trades as well as Furniture Layout Designer for final workstation outlet locations.

3.5.3.5 Where conflict exists between drawings and specifications the Contractor shall, make allowance for provision of the component, system, or installation process in a manner which will provide the highest monetary cost components, systems, or installation process. Contractor shall inform the Owner's Project Managers of the conflict and obtain approvals prior taking corrective measures.

3.5.4 PATHWAYS AND TOPOLOGY

3.5.4.1 Utilize "thin film" lubricants only! It has been shown that cable-pilling lubricants will affect your testing as the cable needs several weeks to dry before attenuation levels recover. Use of incorrect cable lubricants will erode cable jacket and void cable warranty.

3.5.4.2 All cable and wire shall be concealed in conduits, floor ducts, paneling, ceiling or similar areas except at mutually agreed upon areas.

3.5.4.3 Fill capacity in conduit, modular furniture and other horizontal pathways should not exceed 40 percent. A maximum of 60 percent pathway fill is allowed to accommodate unplanned additions after initial installation. The Cat 6A cable is a larger O.D. (0.275 inch – 0.30 inch vs. 0.23 inch for typical for Cat6 cable). The increased diameter of Cat 6A cable will require appropriate design considerations when sizing conduit and other pathways. In most installations, conduit sizes will have to be increased in order to accommodate all of the cables being installed. This will impact the design and material selection of the project. To calculate the fill ratio, divide the sum of the cross-sectional area of all cables, by the most restricted cross-sectional area of the pathway.

3.5.4.4 Fill ratios for Augmented CAT6 cable (CAT6A) requires 1 inch EMT for 4 cables and sized larger for additional cables as required to maintain a 60 percent fill ratio.

3.5.4.5 Flat-rung and/or solid bottom cable tray shall be utilized for large, high-density installations. J-hooks and other specific cable support hardware shall be used at all locations outside of cable tray.

3.5.4.6 Pathway design should not exceed (2) 90 degree bends between pull points or pull boxes (PB). If more than (2) 90 degree bends are required, install a pull box between bends.

3.5.4.7 Provide NEC-sized pullboxes for any run greater than 100 feet, or with more than two ninety-degree bends.

3.5.4.8 J-hooks should be randomly spaced 60 inch or less. Do not exceed J-hook capacity for size and weight limitations.

3.5.4.9 Land wireless access cabling above ceiling, secured onto in-ceiling bracket. A slack loop in the horizontal cabling is not required. Utilize varying-length patch cords when installing wireless access point devices for flexibility in length.

3.5.4.10 Crimp-on plugs at wireless access points are not allowed. Terminate all WAP cabling onto jacks and ceiling-mount brackets and test all cables as appropriate.

3.5.4.11 Mixing of various Category cables in the same pathway is allowed as long as the applications are appropriate for each category of cable used.

3.5.4.12 Prior to placing any cable pathways or cable, the Contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.

3.5.4.13 Maintain a distance of at least 12 inches from all power conduits and cables, and 6 inches from all fluorescent lighting fixtures. Do not install power feeders 100 amps or greater above or within 5 feet of telecommunications backboard. Do not install telecommunications conduits above power panels or switchboards.

3.5.4.14 Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

3.5.4.15 The backbone subsystem shall include cable installed in a vertical manner between floor telecommunications room/closets (TCs or IDFs) and the main or intermediate cross-connect in a multi-story building and cable installed horizontally between telecommunications room/closets and the main or intermediate cross-connect in a long single story building.

3.5.4.16 Unless otherwise recommended by the Owner, all fiber cables will be encased in interlocking armor. All fibers will be terminated in the Telecom Rooms or Cabinets in rack-mounted enclosures equipped with sufficient ports to allow for growth, slack storage space and splice trays if required to terminate and secure all fibers.

3.5.4.17 Adequate riser sleeve/slot space shall be available with the ability to ingress the area at a later date in all Telecommunications rooms/closets, such that no drilling of additional sleeves/slots is necessary. Sleeves may need to be provided and installed under the scope of this Project.

3.5.4.18 The backbone cables shall be installed in a star topology, emanating from the main cross-connect to each telecommunications room/closet. An intermediate cross-connect may be present between the main cross-connect and the horizontal cross-connect.

3.5.4.19 For voice or data applications, 4 pair UTP or fiber optic cables shall be run using a star topology from the telecommunications room/closet serving that floor to every individual information outlet.

3.5.4.20 Backbone and Horizontal pathways shall be installed or selected such that the minimum bend radius is maintained both during and after installation.

3.5.4.21 All horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes.

3.5.4.22 Install ¾ inch x 4 ft x 8 ft fire-rated plywood across all walls in telecom rooms, from 6 inch AFF to 8 ft -6 inch AFF. Coat with two (2) coats of white paint. Do not paint over fire rating stamp.

3.5.4.23 Contractor shall firestop all used pathways which enter or leave the telecom rooms via conduit, cable tray or slot. Contractor is responsible for installing sleeves at each wall or partition penetration, and firestopping all fire-rated penetrations. Intumescent caulk shall be applied around the outside of each sleeve, and intumescent putty inside the sleeve or conduits around the cables. Appropriate fill ratios must be followed when penetrating fire-rated walls.

3.5.4.24 Do not run fiber cables in conduits which are less than 2 inch in diameter.

3.5.4.25 Abandoned cable shall be removed from pathways (i.e., from tunnels, manholes, plenum spaces, and conduit) under scope of this project. Previously unknown or unidentified cable which is apparently abandoned prior to work shall be brought to the attention of the Owner for authorization prior to removal.

3.5.5 GROUNDING:

3.5.5.1 All grounding (earthing) and bonding shall be done to applicable codes, standards and regulations.

3.5.5.2 Shielded cabling channels shall include appropriate method of bonding shield to approved ground for proper EMI/RFI mitigation.

3.5.5.3 Shield Continuity Testing shall be Enabled when shielded cabling channels are installed.

3.5.5.4 All shielded and armored cables shall be bonded to a telecom grounding system via shielded patch panels at the rack locations. Shielded Category-rated connectors must be properly installed to maintain electrical ground conductivity along entire length of cable and at both ends of the cable. UTP connectors shall not be used on shielded cables at either end.

3.5.5.5 Shielded Patch cords shall be provided for use and employed at each workstation location utilizing shielded cable. Shielded patch cords can be identified by their gray color and metallic RJ45 plug. Shielded patch cords are not required at the patch panels.

3.5.5.6 Telecom Contractor shall bond and ground all telecom room metals. Telecom Contractor shall provide and install TIA-rated Telecommunications Grounding Busbar (TGB) at all MDF and IDF locations, and an in-cabinet grounding busbar at each remote wall-mounted cabinet or telecom enclosure. All ground lugs shall be 2-hole make-up.

3.5.5.7 Electrician will provide connection between TGB and building ground; Telecom contractor (if separate, otherwise electrician) will provide a busbar and ground all equipment and telecom metals to the busbar.

3.5.5.8 Telecom installer will ground and bond all armored and/or shielded cables, racks, cabinets, cable tray, ladder racking, and shielded panels to telecom grounding busbar.

3.5.6 CABLES AND TERMINATIONS:

3.5.6.1 Check plans and symbology for final determination of faceplate constitution or consult with Owner prior to bid.

3.5.6.2 Install additional cables at drop locations and in quantities indicated on the drawings. Do not exceed manufacturers' recommendations for maximum allowable pulling tension, side wall pressure or minimum bending radius. Use pulling compound as recommended by cabling manufacturer.

3.5.6.3 All horizontal cables, regardless of media type, shall not exceed 90 m (295 ft) from the telecommunications outlets in the work area to the horizontal cross connect.

3.5.6.4 The combined length of jumpers, or patch cords and equipment cables in the telecommunications room/closet and the work area shall not exceed 10m (33 ft).

3.5.6.5 The Contractor shall observe the bending radius and pulling strength requirements of the 4 pair UTP and fiber optic cable during handling and installation.

3.5.6.6 No run of UTP cable between horizontal portions of the cross-connect in the telecommunication closet and the information outlet shall contain splices.

3.5.6.7 In a false ceiling environment, a minimum of 3 inches (75 mm) shall be observed between the cable supports and the false ceiling. Minimum 6 inch is preferred.

3.5.6.8 J-hooks shall be provided for all suspended cable, at a semi-irregular spacing not to exceed 5 feet between supports. Cables shall be supported by dedicated low-voltage cable support hardware. Support of cables or hanging hardware by means of supports or surfaces related to other trades or applications is not allowed.

3.5.6.9 Provide a full-size service loop (at least once around the inside edge of the box) in each J-box in the communications system.

3.5.6.10 Install all cable in plenum spaces with J-hooks of at least 1" in width to disperse the weight on the bottom cables. Homerun all cable to nearest TR Cabinet.

3.5.6.11 Comply with ANSI/TIA-569 for conduit and splice box sizing.

3.5.6.12 Install modular jacks at all outlets shown; one data jack for each data cable at each faceplate or termination point. Install additional cables and modular jacks as indicated on the drawings. Do not “split pairs” between different jacks.

3.5.6.13 Terminate cables at each jack location and at termination board or patch panel. Follow industry guidelines and manufacturers’ recommendations and procedures as required. All termination hardware shall be rated to exceed their associated Category rating as specified above.

3.5.6.14 Field-installable RJ45 plugs are not to be used.

3.5.6.15 For enclosed ceiling WAP locations, install and terminate cables to approximate location as shown on plans. For open-ceiling environments, secure cables and surface-mount boxes to nearest appropriate support structure.

3.5.6.16 For in-ceiling WAP locations, secure jacks inside a surface-mount block mounted to in-ceiling metal assembly, and provide a 5 ft patch cord or longer, as needed, to connect device to its final determined location in ceiling.

3.5.6.17 For wall-mounted device locations, utilize an in-wall bracket in lieu of faceplate as described above. Secure mounting bracket and device hardware directly over backbox. Connect device with 1 ft patch cord. Coil patch cord inside backbox.

3.5.6.18 Label and identify each outlet and cable for data circuits. Label at outlet end and at termination board or patch panel with matching designations.

3.5.6.19 Provide data outlets in surface raceway at 26 inch on center unless otherwise indicated.

3.5.6.20 Extreme care must be taken not to nick any of the copper conductors when removing jacket. Use rip cord to expose pairs for termination onto Insulation Displacement Contacts. You can also use a precision stripper that allows the technician to set the depth of the blade.

3.5.6.21 Maintain twists as close as possible to the point of termination. Untwisting of copper pairs should not exceed ¼ inch to the termination point.

3.5.6.22 Manage the cable bundles in a symmetrical orientation. For example, in a 48-port patch panel, distribute 24 cables through the vertical cable management on the left rear side of the rack and 24 cables through the vertical cable management on the right rear side of the rack.

3.5.6.23 Do not dress cables in bundles larger than 24 cables. Multiple 24-cable bundles may be run in parallel with evenly-spaced Velcro cable ties in an orderly sequence.

3.5.6.24 For cable management on rear of patch panel, cable shall sweep into termination points and be supported by appropriate rear cable management.

3.5.6.25 Horizontal patch cord management is required on all installations which do not use angled patch panels.

3.5.6.26 Maintain cable bend radius 4X outer diameter (UTP only) when mounting faceplate onto EMT backbox, box-eliminators or furniture knock-outs.

3.5.6.27 Faceplates and SMBs shall be fully installed and labeled prior to testing.

3.5.7 ABOVE-CEILING AND WALL-MOUNTED WIRELESS ACCESS POINTS AND DEVICES

3.5.7.1 WAP, IP Camera and other communications cables shall terminate on patch panels in the TE/TR (IDF).

3.5.7.2 WAP cables shall be supported by an in-ceiling termination bracket. Affixing of a 2-port SMB to the bracket is recommended.

3.5.7.3 SMB, jacks, and patch cords used in plenum spaces shall be plenum-rated.

3.5.7.4 SMB shall be mounted in the ceiling on a specially-designed clip attached to a cable support ceiling wire or threaded rod support per cable management section in Part 2. SMB shall not be tie wrapped to supports, or left on ceiling tiles or other equipment located above the ceiling.

3.5.7.5 Wall-mounted devices not requiring faceplates will be mounted directly to the backbox. Jacks will be secured inside backbox on a specially-designed in-wall bracket clip per cable management section in Part 2.

3.5.8 FURNITURE CABLING

3.5.8.1 The Contractor will pull all voice and data cables in advance of the installation of the modular furniture workstations, and coil at basefeed or above ceiling for power pole feeds. Upon furniture arrival, the Contractor will feed the cables through power poles or base feed/wall connected data/telecom conduit, and terminate as specified on the floor plans.

3.5.8.2 Contractor to coordinate with Owner’s furniture vendor for timing of the installation of systems furniture, and installation of electrical and voice/data cabling. Overtime may be required for this and other phases of the project work, and bids, plans and schedules must reflect actual work demands. Contractor shall consider all costs in their bids for installation.

3.5.9 TERMINAL BLOCKS AND PATCH PANELS:

3.5.9.1 Arrange all terminal blocks in a manner that allows natural wiring progression and minimizes crossing of wires.

3.5.9.2 Dress and comb all incoming cable bundles in groups of 24 cables each. Eliminate crossed cables and “divers”.

3.5.9.3 Ground all shielded patch panels to telecom ground source via paint-piercing washers to a grounded rack, or via direct ground wire to telecom bus bar.

3.5.10 IDF ROOMS

3.5.10.1 The Data and Telco Rooms are a transition point between the backbone and horizontal distribution pathways. The rooms shall be able to contain data or telecommunications’ equipment, cable terminations and associated cross-connection wiring. Closet spaces are not to be shared with electrical installations, other than those directly for telecommunications, video, security and information systems equipment. The rooms are not to be shared with other unrelated building service, for example plumbing. Any conflicts with these specifications require the approval of the Owner’s project manager.

3.5.10.2 Contractor shall submit a drawing of the IDF room showing layout of all components including necessary and required electrical outlets, conduits, environmental requirements and wire termination fields prior to start of the job. Any jack densities noted in these specifications are estimates only. The drawing will designate the most effective, scalable, jack termination cabling design to facilitate data/telecom outlets shown on the lease exhibits. Owner’s Project Managers must approve drawings prior to installation.

3.5.10.3 All racks, panels, and equipment finished shall be anchored to meet local seismic zone requirements and industry standards. The equipment racks are to be anchored to the concrete floors via “Unistrut or equal metal framing strut systems”, threaded rod, concrete anchors, bolts and washers.

3.5.10.4 The overhead cable ladder system will provide a route for the Category 6 and 6A, and other communication cables while providing stability to the equipment racks.

3.5.10.5 The vendor is responsible to provide and install the specified count of 19 inch EIA rack-mount 7 ft (45U) 2- post racks, Black, as required in the new IDF. The vendor is responsible for submitting IDF layout drawings to Owner for approval prior to installation.

3.5.10.6 The Contractor shall provide high capacity horizontal and vertical cable manager channels are required in all data and equipment racks, and the racks will contain sufficient vertical and horizontal cable managers to facilitate the patch panel density and placement installed by the contractor.

3.5.10.7 Contractor will install raceways, boxes, managers, and enclosures as indicated according to manufacturer's written instructions. Securely fasten each component to the surface to which it is mounted and remove burs and sharp edges from all cable tray.

3.5.10.8 A 12 inch ladder rack system is required and will be provided by the contractor and installed in the IDF to provide cable support to the rack system. This includes all of the required ladder rack support items such as rack to runway kits, wall angle brackets, ceiling supports, splices (junction and butt), radius drops and j-bolts. The final ladder rack layout will be included in the IDF layout drawing described above.

3.5.10.9 Provide and install as needed in the IDF room 4 ft x 8 inch x ¾ inch fire-rated plywood board and labeled with fire rating stamp facing into the room to accommodate rack ladder support, cabling support, grounding platform, data and voice equipment. Paint backboard white (leave stamp visible) to match existing backboard in room, if appropriate. Location of installation is to be determined with approval by Owner.

3.5.11 PATCH CORDS:

3.5.11.1 Contractor to provide and install fiber and copper patch cords in quantities as described below. Neatly install patch cords in lengths as appropriate to reduce unnecessary length in wire managers.

3.5.11.2 Install patch cords at the equipment cabinet between patch panel and owner-provided switches for each patch panel and workstation location. Patch cords shall direct-connect between patch panel and networking switch or other electronics equipment. Dress and bundle patch cords as appropriate for final installation. Provide any unused equipment patch cables to Owner in original packaging upon completion of project.

3.5.11.3 Install Wireless Access Point patch cords as described above, and connect Cameras and other field-installed networkable device via a vendor-supplied patch cord at the remote locations. Return unused patch cords to Owner in original packaging.

3.5.11.4 Provide workstation patch cords to Owner in original packaging.

3.5.11.5 Use the following guidelines for project bid. Verify all lengths with Owner prior to purchase:

3.5.11.5.1 Provide and install one (1) 7-foot patch cord, of the same category rating, for each cable terminated at the patch panel

3.5.11.5.2 Provide one (1) 10-foot patch cord, of the same category rating, for each cable terminated at the terminal outlet location

3.5.11.5.3 Provide one (1) 2-meter patch cord, of the same grade of fiber, for each LC connector pair installed at the IDF, MDF, and all other terminal enclosure locations.

3.5.11.6 All fiber patch cords and required workstation/equipment patch cords not installed shall be provided in hand to Owners Representative prior to project closeout.

3.5.12 LABELING

3.5.12.1 Provide machine-generated labels appropriate for all components supplied and installed. Under no circumstances shall hand written labels be used.

3.5.12.2 Each faceplate, cable, or data outlet (drop) will be numbered with a unique identifier clearly indicating the voice and data jacks by floor number, station, and outlet identification. This labeling scheme will be independent of any assigned telephone numbers.

3.5.12.3 The labeling scheme shall not include duplicates of any new or existing cable identification across the entire cable plant.

3.5.12.4 Labeling procedure will meet TIA-568, TIA-606 (Class 2 Administration) and BICSI Standards.

3.5.12.5 The labeling scheme will be provided at all locations within the cable infrastructure:

3.6 TESTING

3.6.1 COPPER TESTING

3.6.1.1 Test all equipment and each outlet, horizontal cable, termination block, patch cords, etc. to verify compliance with requirements. Testing shall consist of attenuation and NEXT across all splices and devices installed in the field and shall meet latest requirements of EIA/TIA. Re-terminate any cable or connection found to be defective.

3.6.1.2 Tester is to be a Level IV device or better, and configured with the specific cable installed, and the Permanent Link test will be performed according to the Category's standard methodology. All parameters must exhibit a PASS test result prior to project completion. PASS*, FAIL* or FAIL test results will not be accepted.

3.6.1.3 Only a permanent link test for Category 6A will be required. If situations demand a "hybrid", "Mixed" or a standard "Channel" design, approval must be obtained for those specific circumstances prior to testing.

3.6.2 FIBER OPTIC TESTING

3.6.2.1 Each pre-terminated fiber strand shall be tested for continuity and attenuation with an Optical Power Meter and light source for actual length and splice/connector loss. Each field-terminated fiber strand (if any) shall be tested for attenuation with an Optical Power Meter and light source and with an Optical Time Domain Reflectometer (OTDR) for actual length and splice/connector loss.

3.6.2.2 Cable length shall be verified using sheath markings. The guidelines and procedures established for Tier 1 testing in TIA/TSB-140 shall apply.

3.6.2.3 All fiber optic cables shall be tested from the site's MDF to each fiber terminals located in the IDF.

3.6.2.4 The Contractor shall conduct a bi-directional power meter (loss) test of each fiber optic station and riser cable at both wavelengths, 850/1300nm for MM and 1310/1550nm for SM.

3.6.2.5 No individual station or riser fiber link segment (including connectors) shall measure more than 2.0 dB loss for LC, and 1.5dB loss for MTP. LC links shall be tested with LC jumpers from the LC cassette to the tester. MTP links shall be tested either with an MTP tester and array cord, or with an MTP-LC breakout harness and LC duplex fiber tester.

3.6.2.6 Tests shall be conducted using ANSI/TIA-526-14A, Method B. Test results evaluation for the panel to panel (backbone) shall be based on the values set forth in ANSI/TIA-568.

3.6.2.7 The Contractor shall provide an electronic printout for each strand tested with the Power Meter and the OTDR.

3.6.2.8 Where concatenated links are installed to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. After the link performance test has been successfully completed, each link shall be concatenated and tested. The test method shall be the same used for the test described above. The evaluation criteria shall be established between the Owner and the Contractor prior to the start of the test.

3.6.2.9 All installed cables must meet or exceed the defined standards for performance. The Contractor shall take all steps and all expense necessary to clean, repair or replace any optic link not meeting the standard.

3.6.3 TEST RESULTS

3.6.3.1 Repair and resolve any shortcomings in the test results. Mitigation efforts may require re-termination or replacement of the jack, outlet or cable. Repairs or attempts to resolve test failures will be completed solely at the expense of the Contractor.

3.6.3.2 Provide test results to Manufacturer and Owner representative in native Tester format. Upon request, provide a copy of the tester software and license, if needed, at no charge to Owner representative.

3.6.3.3 Include PDF of full test results, summary index in electronic format on CD or memory stick in the O&M package upon project completion.

3.6.3.4 Cabling systems shall meet or exceed the electrical and transmission characteristics of the systems specified.

3.6.3.5 Cable segments and links shall be tested from both ends of the cable for each of the construction phases. (Verify that cable labeling matches at both ends).

3.6.3.6 The system shall not be considered certified until the tester has acknowledged that the performance of the physical layer of the system has been fully tested and is operational at the completion of the installation phase.

3.6.3.7 After the installation is complete, in addition to any other required testing as described herein, and at such times as the Owner/Engineer directs, the Contractor shall be present while the Owner conducts an operating test for approval. The installation shall be demonstrated to be in accordance with the requirements of this specification. Any defects revealed shall be corrected promptly at the Contractor's expense and the tests performed again.

3.6.3.8 After review of the completed test results, the Owner reserves the right to retest cables, utilizing the Contractor's tester and the Contractor's labor.

3.6.3.9 The test results information for each link shall be recorded in the memory of the field tester upon completion of the test. The tester shall be capable of storing test data in either internal or external memory. The external media used shall be left to the discretion of the user.

3.6.3.10 Test results saved by the tester shall be transferred into a Windows based database utility that allows for maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered as well as any printed reports generated from the software application.

3.6.3.11 Test results shall be provided in both native Tester format as well as comma separated variable (.csv), Portable Document File (.pdf), plain text (.txt), or hypertext markup language (.html/.htm). A copy of the tester native test software must be provided to Owner or Owner’s representative for comparison of results.

3.6.3.12 Test Results for CAT6 shall include the following:

3.6.3.12.1 Applicable room number of jack location (room number per Contract Documents)

3.6.3.12.2 Applicable Telecommunications Room number

3.6.3.12.3 Circuit I.D. number with corresponding jack identifier

3.6.3.12.4 Wire Map – shall include the following:

3.6.3.12.4.1 Continuity to the remote end

3.6.3.12.4.2 Shorts between any two or more conductors

3.6.3.12.4.3 Crossed pairs

3.6.3.12.4.4 Reversed pairs

3.6.3.12.4.5 Split pairs

3.6.3.12.4.6 Any other mis-wiring

3.6.3.12.5 Length

3.6.3.12.6 Insertion Loss

3.6.3.12.7 Near-end Crosstalk (NEXT) Loss

3.6.3.12.8 PS-NEXT (Power Sum Near End Cross Talk)

3.6.3.12.9 FEXT (Far End Crosstalk)

3.6.3.12.10 ELFEXT (Equal Level Far End Cross Talk)

3.6.3.12.11 PS-ELFEXT (Power Sum Equal Level Far End Cross Talk)

3.6.3.12.12 Propagation Delay

3.6.3.12.13 Delay Skew

3.6.3.12.14 Return loss

3.6.3.12.15 PSFEXT (Power Sum Far End Crosstalk)

3.6.3.12.16 PSACRF (Power Sum Attenuation to Crosstalk Ratio, Far End)

3.6.3.13 Test Results for CAT6A shall include all of the above, plus the following:

3.6.3.13.1 AACRF (Alien Attenuation to Crosstalk Ratio, Far End)

3.6.3.13.2 AFEXT (Alien Far End Crosstalk)

3.6.3.13.3 ANEXT (Alien Near End Crosstalk)

3.6.3.13.4 PSANEXT (Power Sum Alien Near End Crosstalk)

3.6.3.13.5 PSAACRF (Power Sum Alien Attenuation to Crosstalk Ratio, Far End)

Approved Tester Products:

Softing WireXpert series tester
Fluke DTX or later platform Cable Certification testers
Linkware Record Management Software

3.7 PROJECT CLOSEOUT

3.7.1 Operating and maintenance manuals shall be submitted prior to testing of the system. A total of three (3) manuals shall be delivered to the Owner. Manuals shall include all service, installation, and programming information.

3.7.2 Provide a full set of “as-built” (redline) drawings in AutoCAD DWG and PDF format. Drawings to depict final location and drop/cable identification numbers and labels which match the test reports. Include (1) hard copy paper format of all as-builts in 30 inch x 42 inch size or equivalent, posted in each telecom room involved in the project.

3.7.3 Contractor to provide all warranty information to Leviton for processing. Leviton will send warranty document direct to Owner.

3.8 TRAINING

3.8.1 Provide 4 hours training on the operation and installation of the data system, at job site, at no cost to Owner.

END OF SECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

1.2.1 Section includes:

1.2.1.1 Pathways.

1.2.1.2 UTP cabling.

1.2.1.3 Coaxial cable.

1.2.1.4 Multiuser telecommunications outlet assemblies.

1.2.1.5 Cable connecting hardware, patch panels, and cross-connects.

1.2.1.6 Telecommunications outlet/connectors.

1.2.1.7 Cabling system identification products.

1.2.1.8 Cable management system.

1.2.2 Related Sections:

1.2.2.1 Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.

1.2.2.2 Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices

1.3 DEFINITIONS

1.3.1 BICSI: Building Industry Consulting Service International

1.3.2 Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

1.3.3 Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

1.3.4 EMI: Electromagnetic interference.

1.3.5 IDC: Insulation displacement connector

1.3.6 LAN: Local area network.

1.3.7 MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.

1.3.8 Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

1.3.9 RCDD: Registered Communications Distribution Designer.

1.3.10 UTP: Unshielded twisted pair

1.4 HORIZONTAL CABLING DESCRIPTION

1.4.1 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 "permanent link," a term that is used in the testing protocols.

1.4.1.1 TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.

1.4.1.2 Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.

1.4.1.3 Bridged taps and splices shall not be installed in the horizontal cabling.

1.4.1.4 Splitters shall not be installed as part of the optical fiber cabling.

1.4.2 A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

1.4.3 The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect

1.5 PERFORMANCE REQUIREMENTS

1.5.1 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.

1.6 SUBMITTALS

1.6.1 Product Data: For each type of product indicated.

1.6.2 Retain subparagraph below for coaxial cable. Installation data for UTP and optical fiber cabling are specified in the referenced TIA/EJA standards.

1.6.2.1 For coaxial cable, include the following installation data for each type used:

1.6.2.1.1 Nominal OD.

1.6.2.1.2 Minimum bending radius.

1.6.2.1.3 Maximum pulling tension.

1.6.3 Shop Drawings:

1.6.4 Retain one of first two subparagraphs below.

1.6.4.1 System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

1.6.4.2 System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.

1.6.4.3 Cabling administration drawings and printouts.

1.6.4.4 Wiring diagrams to show typical wiring schematics, including the following:

1.6.4.4.1 Cross-connects.

1.6.4.4.2 Patch panels.

1.6.4.4.3 Patch cords.

1.6.4.5 Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

1.6.4.6 Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

1.6.4.6.1 Vertical and horizontal offsets and transitions.

1.6.4.6.2 Clearances for access above and to side of cable trays.

1.6.4.6.3 Vertical elevation of cable trays above the floor or bottom of ceiling structure.

1.6.4.6.4 Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

1.6.4.6.5 Retain first paragraph below when workstation outlet faceplates have critical features needing hands-on appraisal.

1.6.4.6.6 Remaining paragraphs are defined in Division 01 Section “Submittal Procedures" as "Informational Submittals."

1.6.4.6.7 Coordinate first paragraph below with qualification requirements in Division 01 Section “Quality Requirements” and as supplemented in “Quality Assurance" Article.

1.6.5 Qualification Data: For [Installer,] qualified layout technician, installation supervisor, and field inspector.

1.6.6 Source quality-control reports.

1.6.7 Retain first paragraph below if Contractor is responsible for field quality-control testing and inspecting.

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

1.6.9 Retain paragraph below for PC-based cabling administration systems.

1.7 QUALITY ASSURANCE

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

1.7.1.1 Layout Responsibility: Preparation of Shop Drawings [and Cabling Administration Drawings] [Cabling Administration Drawings, and field testing program development] by an RCDD.

1.7.1.2 Installation Supervision: Installation shall be under the direct supervision of [Registered Technician] [Level 2 Installer], who shall be present at all times when Work of this Section is performed at Project site.

1.7.1.3 Delete subparagraph below if Contractor performs field quality control.

1.7.1.4 Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on- site testing.

1.7.1.5 Retain first paragraph below if Contractor or manufacturer selects testing agency or if Contractor is required to provide services of a qualified testing agency in "Field Quality Control" Article. Qualification requirements are in addition to those specified in Division 01 Section "Quality Requirements," which also includes the definition for "NRTL" (nationally recognized testing laboratory).

1.7.2 Testing Agency Qualifications: An NRTL.

1.7.2.1 Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.7.3 Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.7.3.1 Flame-Spread Index: [25] <Insert value> or less.

1.7.3.2 Smoke-Developed Index: [50] [450] <Insert value> or less.

1.7.4 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.

1.7.5 Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

1.7.6 Grounding: Comply with ANSI-J-STD-607-A.

1.8 DELIVERY, STORAGE, AND HANDLING

1.8.1 Test cables upon receipt at Project site.

1.8.2 Retain one or both of first two subparagraphs below.

1.8.2.1 Test optical fiber cables to determine the continuity of the strand end to end. Use [optical fiber flashlight] [or] [optical loss test set] <Insert test>.

1.8.2.2 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.

1.8.2.3 Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

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

1.10 COORDINATION

1.10.1 Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.10.2 Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.10.3 Services in this article may not be allowed for publicly funded projects.

1.10.4 Retain this article for computer-based, special-purpose cabling administration software.

PART 2 - PRODUCTS

2.1 PATHWAYS

2.1.1 General Requirements: Comply with TIA/EIA-569-A.

2.1.2 Retain first paragraph below if cable support brackets are used in communications equipment room.

2.1.3 Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

2.1.3.1 Support brackets with cable tie slots for fastening cable ties to brackets.

2.1.3.2 Lacing bars, spools, J-hooks, and D-rings.

2.1.3.3 Straps and other devices.

2.1.4 Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used, no exceptions.

2.1.4.1 Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

2.2.1 Backboards: Plywood, fire-retardant treated, *314* by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE

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

2.3.1.1 Belden CDT Inc.; Electronics Division.

2.3.1.2 CommScope, Inc.

2.3.1.3 Superior Essex Inc.

2.3.2 Description: 100-ohm, 4-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.

2.3.2.1 Comply with ICEA S-90-661 for mechanical properties.

2.3.2.2 Comply with TIA/EIA-568-B.1 for performance specifications.

2.3.2.3 Comply with TIA/EIA-568-B.2, Category 6.

2.3.2.4 Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

2.3.2.4.1 Communications, General Purpose: Type CM or CMG [; or MPP, CMP, MPR, CMR, MP, or MPG].

2.3.2.4.2 Communications, Plenum Rated: Type CMP [or MPP], complying with NFPA 262.

2.3.2.4.3 Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.

2.4 UTP CABLE HARDWARE

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

2.4.1.1 Ortronics.

2.4.1.2 Hubbell Premise Wiring.

2.4.1.3 Leviton Voice & Data Division.

2.4.2 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.

2.4.3 Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 spares. Integral with connector bodies, including plugs and jacks where indicated.

2.4.4 Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

2.4.5 Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

2.4.6 Patch Cords: Factory-made, four-pair cables in 48-inch lengths; terminated with eight- position modular plug at each end.

2.4.6.1 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.

2.4.6.2 Patch cords shall have color-coded boots for circuit identification.

2.5 OPTICAL FIBER CABLE

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

2.5.1.1 Superior Essex Inc.

2.5.1.2 Berk-Tek; a Nexans company.

2.5.1.3 General Cable Technologies Corporation.

2.5.2 Description: Singlemode, 562.5/125-micrometer, 24-fiber, tight buffer, optical fiber cable.

2.5.2.1 Comply with ICEA S-83-596 for mechanical properties.

2.5.2.2 Comply with TIA/EIA-568-B.3 for performance specifications.

2.5.2.3 Comply with [TIA/EIA-492AAAA-B] [TIA/EIA-492AAAA-A] for detailed specifications.

2.5.2.4 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:

2.5.2.4.1 General Purpose, Nonconductive: Type OFN or OFNG.

2.5.2.4.2 Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

2.5.2.4.3 Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.

2.5.2.5 Conductive cable shall be [steel] [aluminum] armored type.

2.5.2.6 Maximum Attenuation: [3.50] dB/km at 850 nm.

2.5.2.7 Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

2.5.3 Jacket:

2.5.3.1 Jacket Color: Aqua for 50/125-micrometer cable, Yellow for single mode, Orange for 62.5/125-micrometer cable.

2.5.3.2 Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA- 598-B.

2.5.3.3 Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.6 OPTICAL FIBER CABLE HARDWARE

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

2.6.1.1 Ortronics

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

2.6.3 Coordinate subparagraph below with Drawings for quantity of connectors.

2.6.3.1 Number of Connectors per Field: [One] <Insert number> for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

2.6.4 Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

2.6.5 Cable Connecting Hardware:

2.6.5.1 Comply with Optical Fiber Connector Intermate ability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

2.6.5.2 Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.

Please clarify →

2.6.5.3 Type Small form fiber connectors may be used in termination racks, panels, and equipment packages.

2.7 COAXIAL CABLE

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

2.7.1.1 Alpha Wire Company.

2.7.1.2 Belden CDT Inc.; Electronics Division.

2.7.1.3 CommScope, Inc.

2.7.2 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.

2.7.3 RG-11/U: NFPA 70, Type CATV.

2.7.3.1 No. 14 AWG, solid, copper-covered steel conductor.

2.7.3.2 Gas-injected, foam-PE insulation.

2.7.3.3 Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.

2.7.3.4 Jacketed with sunlight-resistant, black PVC or PE.

2.7.3.5 Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.

2.7.4 RG-6/U: NFPA 70, Type CATV or CM.

2.7.4.1 No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.

2.7.4.2 Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.

2.7.4.3 Jacketed with black PVC or PE.

2.7.4.4 Suitable for indoor installations.

2.7.5 RG59/U (Plenum Rated): NFPA 70, Type CMP.

2.7.5.1 No. 20 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.

2.7.5.2 Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.

2.7.5.3 Copolymer jacket.

2.7.6 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:

2.7.6.1 CATV Cable: Type CATV, or CATVP or CATVR.

2.7.6.2 CATV Plenum Rated: Type CATVP, complying with NFPA 262.

2.7.6.3 CATV Riser Rated: Type CATVR; or CATVP, CATVR, or CATV, complying with UL 1666.

2.7.6.4 CATV Limited Rating: Type CATVX.

2.8 COAXIAL CABLE HARDWARE

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

2.8.1.1 Aim Electronics; a brand of Emerson Electric Co.

2.8.1.2 Leviton Voice & Data Division.

2.8.1.3 Siemon Co. (The).

2.8.2 Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.9 CONSOLIDATION POINTS

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

2.9.1.1 DAMAC

2.9.1.2 Chatsworth Products, Inc.

2.9.1.3 Hubbell Premise Wiring.

2.9.2 Description: Consolidation points shall comply with requirements for cable connecting hardware.

2.9.2.1 Number of Terminals per Field: One for each conductor in assigned cables.

2.9.2.2 Number of Connectors per Field:

2.9.2.2.1 One for each four-pair UTP cable indicated

2.9.2.2.2 One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.

2.9.2.3 Mounting: Recessed in ceiling, Wall.

2.9.2.4 NRTL listed as complying with UL 50 and UL 1863.

2.9.2.5 When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.10 MULTIUSER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

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

2.10.1.1 DAMAC

2.10.1.2 Chatsworth Products, Inc.

2.10.1.3 Hubbell Premise Wiring.

2.10.2 Description: MUTOAs shall meet the requirements for cable connecting hardware

2.10.2.1 Number of Terminals per Field: One for each conductor in assigned cables.

2.10.2.2 Coordinate first subparagraph below with Drawings for quantity of connectors.

2.10.2.3 Number of Connectors per Field:

2.10.2.3.1 One for each four-pair UTP cable indicated.

2.10.2.3.2 One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.

2.10.2.4 Mounting: Recessed in ceiling, Wall.

2.10.2.5 NRTL listed as complying with UL 50 and UL 1863.

2.10.2.6 Label shall include maximum length of work area cords, based on TIA/EIA-568- B.1.

2.10.2.7 When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.11 TELECOMMUNICATIONS OUTLET/CONNECTORS

2.11.1 Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

2.11.2 Workstation Outlets: Four-port-connector assemblies mounted in [multigang faceplate.

2.11.2.1 Metal Faceplate: Stainless steel, complying with requirements in Division 26 Section "Wiring Devices."

2.11.2.2 For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.

2.11.2.2.1 Flush mounting jacks, positioning the cord at a 45-degree angle.

2.11.2.2.2 Retain one of three subparagraphs below; retain first for metal faceplates.

2.11.2.3 Legend: Factory labeled by silk-screening or engraving for stainless steel faceplates.

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

2.11.2.5 Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.12 GROUNDING

2.12.1 Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

2.12.2 Comply with ANSI-J-STD-607-A.

2.13 IDENTIFICATION PRODUCTS

2.13.1 Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.13.2 Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.14 CABLE MANAGEMENT SYSTEM

2.14.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following;

2.14.2 Basis-of-Design Product: Subject to compliance with requirements, comparable product by one of the following:

2.14.2.1 iTRACS Corporation.

2.14.2.2 Telsoft Solutions.

2.14.3 Description: Computer-based cable management system, with integrated database and graphic capabilities.

2.14.4 First paragraph below specifies identification that is integrated with database functions, testing, and graphics.

2.14.5 Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.

2.14.6 Information shall be presented in database view, schematic plans, or technical drawings.

2.14.6.1 AutoCAD drawing software shall be used as drawing and schematic plans software.

2.14.7 System shall interface with the following testing and recording devices:

2.14.7.1 Direct upload tests from circuit testing instrument into the personal computer.

2.14.7.2 Direct download circuit labeling into labeling printer.

2.15 SOURCE QUALITY CONTROL

2.15.1 Testing Agency: Engage a qualified testing agency to evaluate cables.

2.15.2 Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

2.15.3 Factory test UTP cables according to TIA/EIA-568-B.2.

2.15.4 Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

2.15.5 See Division 01 Section "Quality Requirements" for retesting and reinspection requirements and Division 01 Section "Execution" for requirements for correcting the Work.

2.15.6 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.

2.15.7 Cable will be considered defective if it does not pass tests and inspections.

2.15.8 Prepare test and inspection reports.

PART 3 – EXECUTION

3.1 ENTRANCE FACILITIES

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

3.2 WIRING METHODS.

3.2.1 Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

3.2.1.1 Install plenum cable in environmental air spaces, including plenum ceilings.

3.2.1.2 Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

3.2.2 Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

3.2.3 Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

3.3.1 Coordinate cable connection hardware installations and specialty arrangements with layout drawings and with requirements specified for communications equipment rooms. If Drawings are explicit enough, these requirements may be reduced or omitted.

3.3.2 Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

3.3.3 Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

3.3.4 Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

3.3.5 Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.3.6 Pathway Installation in Communications Equipment Rooms:

3.3.6.1 Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.

3.3.6.2 Install cable trays to route cables if conduits cannot be located in these positions.

3.3.6.3 Secure conduits to backboard when entering room from overhead.

3.3.6.4 Extend conduits [3 inches (76 mm)] <Insert dimension> above finished floor.

3.3.6.5 Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.3.7 Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

3.4.1 Comply with NECA 1.

3.4.2 General Requirements for Cabling:

3.4.2.1 Comply with TIA/EIA-568-B .1.

3.4.2.2 Comply with BICSI ITSIM, Ch. 6, and “Cable Termination Practices."

3.4.2.3 Install 110-style IDC termination hardware unless otherwise indicated.

3.4.2.4 MUTOA shall not be used as a cross-connect point.

3.4.2.5 Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:

3.4.2.5.1 Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.

3.4.2.5.2 Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.

3.4.2.6 Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

3.4.2.7 Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

3.4.2.8 Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

3.4.2.9 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.

3.4.2.10 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.

3.4.2.11 Cold-Weather Installation: Bring cable to room temperature before unreeling. Heat lamps shall not be used for heating.

3.4.2.12 In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.

3.4.2.13 Pulling Cable: Comply with BICSI ITSIM, Ch. 4, and “Pulling Cable." Monitor cable pull tensions.

3.4.3 UTP Cable Installation:

3.4.3.1 Comply with TIA/EIA-568-B.2.

3.4.3.2 Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

3.4.4 Optical Fiber Cable Installation:

3.4.4.1 Comply with TIA/EIA-568-B.3.

3.4.4.2 Cable may be terminated on connecting hardware that is rack or cabinet mounted.

3.4.4.3 Free Air Installer must be ran in Carlon 1” to 1 ¼” minimum inner duct.

3.4.5 Open-Cable Installation:

3.4.5.1 Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

3.4.5.2 Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than [60 inches (1524 mm)] <Insert dimension> apart.

3.4.5.3 Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

3.4.6 Outdoor Coaxial Cable Installation:

3.4.6.1 Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed 0-rings to keep out moisture.

3.4.6.2 Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

3.4.7 Group connecting hardware for cables into separate logical fields.

3.4.8 Separation from EMI Sources:

3.4.8.1 Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

3.4.8.2 Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

3.4.8.2.1 Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).

3.4.8.2.2 Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).

3.4.8.2.3 Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3.4.8.3 Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

3.4.8.3.1 Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).

3.4.8.3.2 Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).

3.4.8.3.3 Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

3.4.8.4 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:

3.4.8.4.1 Electrical Equipment Rating Less Than 2 kVA: No requirement.

3.4.8.4.2 Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).

3.4.8.4.3 Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

3.4.8.5 Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

3.4.8.6 Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

3.5.1 Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5.2 Comply with TIA/EIA-569-A, Annex A, "Firestopping."

3.5.3 Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

3.6.1 Install grounding according to BICSI TDMM, “Grounding, Bonding, and Electrical Protection" Chapter.

3.6.2 Comply with ANSI-J-STD-607-A.

3.6.3 Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) 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.

3.6.4 Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

3.7.1 Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.7.2 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.

3.7.3 Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

3.7.4 Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for [Class 2] [Class 3] [Class 4] level of administration [, including optional identification requirements of this standard].

3.7.5 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.

3.7.6 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.

3.7.7 Cable and Wire Identification:

3.7.7.1 Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

3.7.7.2 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.

3.7.7.3 Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).

3.7.7.4 Label each terminal strip and screw terminal in each cabinet, rack, or panel.

3.7.7.4.1 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.

3.7.7.4.2 Label each unit and field within distribution racks and frames.

3.7.7.5 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.

3.7.7.6 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.

3.7.8 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.

3.7.8.1 Cables use flexible vinyl or polyester that flex as cables are bent.

3.8 FIELD QUALITY CONTROL.

3.8.1 Testing Agency: Engage a qualified testing agency to perform tests and inspections.

3.8.2 Tests and Inspections:

3.8.2.1 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.

3.8.2.2 Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.

3.8.2.3 Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3.8.2.4 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.

3.8.2.4.1 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.

3.8.2.5 Optical Fiber Cable Tests:

3.8.2.5.1 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.

3.8.2.5.2 Link End-to-End Attenuation Tests:

3.8.2.5.2.1 Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.

3.8.2.5.2.2 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.

3.8.2.6 UTP Performance Tests:

3.8.2.6.1 Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-8.1 and TIA/EIA-568-8.2:

3.8.2.6.1.1 Wire map.

3.8.2.6.1.2 Length (physical vs. electrical, and length requirements).

3.8.2.6.1.3 Insertion loss.

3.8.2.6.1.4 Near-end crosstalk (NEXT) loss.

3.8.2.6.1.5 Power sum near-end crosstalk (PSNEXT) loss.

3.8.2.6.1.6 Equal-level far-end crosstalk (ELFEXT).

3.8.2.6.1.7 Power sum equal-level far-end crosstalk (PSELFEXT).

3.8.2.6.1.8 Return loss.

3.8.2.6.1.9 Propagation delay.

3.8.2.6.1.10 Delay skew.

3.8.2.7 Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-8 .1 and TIA/EIA-568-8.3.

3.8.2.8 Retain first subparagraph below when cable is used for broadband closed-circuit television applications. Revise to suit tests to verify cable performance for other systems using coaxial cable.

3.8.2.9 Coaxial Cable Tests: Conduct tests according to Division 27 Section "Master Antenna Television System."

3.8.2.10 Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.

3.8.2.10.1 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.

3.8.2.10.2 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.

3.8.3 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.

3.8.4 See Division 01 Section "Quality Requirements" for retesting and reinspection requirements and Division 01 Section "Execution" for requirements for correcting the Work.

3.8.5 End-to-end cabling will be considered defective if it does not pass tests and inspections.

3.8.6 Prepare test and inspection reports.

3.9 DEMONSTRATION

3.9.1 Engage a factory-authorized service representative to train District'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 software.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

1.1.1 DESCRIPTION Provide COMMUNICATIONS INFRASTRUCTURE, including backboards, termination devices, outlet and premise wiring as shown and specified per Contract Documents.

1.1.2 Related Sections:

1.1.3 Division 16, all applicable sections.

1.2 REFERENCES OF INDUSTRY STANDARDS TO ADHERE TO

1.2.1 TIA/EIA 568-B.1, B.2, B.3 - Commercial Building Telecommunication Cabling Standard, Part 1: General Requirements, Part 2: Balanced Twisted Pair Cabling Components & Part 3: Optical Fiber Cabling Components Standard.

1.2.2 TIA/EIA 569-A - Commercial Building Standard for Telecommunications Pathways and Spaces,

1.2.3 TIA/EIA 606-A-Administration Standard for Commercial Telecommunications Infrastructure.

1.2.4 ANSI/TIA/EIA-607-A: Commercial Building Grounding and Bonding Requirements for Telecommunications.

1.2.5 TIA/EIA 942- Telecommunications Standard for Data Centers (2005)

1.2.6 NETA ATS (International Electrical Testing Association)-Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.2.7 Article 250 of the 2001 California Electrical Code (CEC).

1.2.8 Article 800 of the 2001 California Electrical Code (CEC).

1.2.9 ANSI/NECA/BICSI Telecommunications Distribution Methods Manual (TDMM), BICSI Cabling Installation Manual and BICSI LAN Design Manual, BICSI Customer-Owned Outside Plant Design Manual.

1.2.10 FCC Part 58.500.

1.2.11 NFPA 70

1.3 DIVISION OF RESPONSIBILITY

1.3.1 Owner:
1.3.1.1 All Local Area Network (LAN) hub equipment

1.3.1.2 All active electronics required at the telecom room.

1.3.1.3 Server Room Cabinets

1.3.2 Contractor:

1.3.2.1 As indicated on plans and specifications.

1.3.2.2 Testing

1.4 SYSTEM DESCRIPTION

1.4.1 Horizontal Pathway: Conform to TIA/EIA 569-A, using raceway, backboards, and cabinets as indicated.

1.4.2 Grounding System: Conform to TIA/EIA 607/942.

1.4.3 Voice Backbone Wiring: Complete from the Main Cross-connect to each Intermediate Cross-connect, using copper and optical fiber backbone cables.

1.4.4 Data Backbone Wiring: Complete from the Main Cross-connect to each Intermediate Cross-connect, using optical fiber backbone cables.

1.4.5 Voice Horizontal Wiring: Complete from horizontal Cross-connects to each outlet using balanced twisted pair horizontal cables.

1.4.6 Data Horizontal Wiring: Complete from horizontal Cross-connects to each outlet using balanced twisted pair and optical fiber backbone cables.

1.4.7 CATV Horizontal Wiring: Complete from Head-end equipment using RG6 Plenum rated cable if required.

1.5 ADDITIONAL ITEMS

1.5.1 While the County Telecommunications has attempted to provide a complete listing of all cables and components needed, it is the Proposer's responsibility to insure the completeness and accuracy of its proposal. Any item not specified, but required to complete the communications cabling system, must be included.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.1.1 Racks and ladders:

2.1.1.1 CPI

2.1.1.2 Approved equal

2.1.2 Cable management, optical fiber enclosures, patch panels, standoff brackets, and outlets:

2.1.2.1 Ortronics

2.1.2.2 Approved equal

2.1.3 Copper backbone cable:

2.1.3.1 BICC General

2.1.3.2 Approved equal

2.1.4 Optical fiber backbone cable, horizontal cable:

2.1.4.1 Superior Essex

2.1.4.2 BICC General

2.1.4.3 Approved equal

2.1.5 All wiring and devices must be from a single manufacturer, or from a group of manufacturers that have teamed together to provide a system solution guaranteed to meet the performance specification.

2.2 SUBMITTALS

2.2.1 The following must be submitted within (30) calendar days after award of the contract and before fabrication and installation of any materials. Submit for approval six (6) copies.

2.2.2 A complete list of equipment and materials, including manufacturer's descriptive and catalog cuts sheets.

2.2.3 Company Certification: The Proposer must be certified by the manufacturer of the submitted system. If different manufacturers will be used there must be a company certification for each, and its use to be approved and authorized by County Telecommunications Staff. The Proposer must provide evidence of this certification as part of the submittal process.

2.2.4 Foreman and Installer Certification: The foreman overseeing the job and all cable installers working on the installation of the communications cabling must be certified by the manufacturer of the submitted system. The Proposer must provide evidence of its certification to install the proposed communications cable and components.

2.2.5 Test Reports: Provide sample test reports for copper, fiber, etc.

2.2.6 All submittals must be checked by the Contractor for conformance to the requirements of the construction documents before forwarding for approval by County Telecommunications Staff Contractor must be responsible for all quantities and errors or omissions of submittals.

2.3 QUALIFICATIONS

2.3.1 Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years experience.

2.3.2 Installer: Company specializing in installing products specified in this section with a minimum three (3) years experience, and with service facilities within 100 miles of project, no exceptions.

2.3.3 Three (3) references from projects of similar size and scope within the last year.

2.3.4 Required Insurances, General Liability and Workman's Compensation in accordance with the County's specific insurance requirements.

2.3.5 The ability to provide a manufacturer's warranty as described in the Warranty Section of this document.

2.4 PRE-INSTALLATION CONFERENCE

2.4.1 Schedule a conference a minimum of five (5) calendar days prior to beginning work.

2.4.2 Clarify any questions related to the work to be performed, scheduling and coordination of materials, working hours, etc

2.4.3 Confirm written submittal and written change process.

2.5 TELECOMMUNICATIONS GROUNDING

2.5.1 Contractor is required to install a complete telecommunications grounding system in compliance with ANSI/TIA/EIA-607: Commercial Building Grounding and Bonding Requirements for Telecommunications (2002), TIA/EIA 942: Telecommunications Standard for Data Centers (2005).

2.5.2 Manufacturer:

2.5.3 DAMAC, Inc.

2.5.4 Approved equal

2.5.5 Product Description: DAMAC PLR1210-3 or Approved equal. U.L. listed, predrilled, electrotin plated copper busbar with holes for standard sized 2 hole compression style lugs mounted on 2-inch insulators.

2.5.6 Dimensions: 4 inches wide x ¼ inch thick x 20 inches long.

2.6 TELEPHONE TERMINATION BACKBOARDS

2.6.1 Product Description: Fire retardant Plywood.

2.6.2 Size: 4 feet x 8 feet, 3/4 inch thick, mounted side by side and vertically so that it covers all walls of each telephone/equipment room. Plywood to be painted to match interior without obscuring fire retardant certification label

2.7 FLOOR MOUNT EQUIPMENT RACKS

2.7.1 Product Description: DAMAC CS84EDB1BSS3 , or approved equal, double side drilled, floor supported, bolt able to floor, with an opening at center of the base for cable entry. UL Listed with two top angles.

2.7.2 Dimensions: 19 inch relay racks 84 inch tall, Universal E.I.A. (0.25 inch Flange / 0.17 inch Web) channels, with EIA standard hole spacing.

2.7.3 Construction: 6061-T6 aluminum, Seismic zone 4.

2.7.4 Finish: Clear.

2.7.5 Each rack must have a 2-hole compression style grounding lug.

2.7.6 Each rack shall be secured to the floor utilizing threaded sleeves that insert into the floor. Stud type mounts that protrude from the floor will not be accepted.

2.8 EQUIPMENT ROOM CABLE MANAGEMENT

2.8.1 Horizontal Cable Management System

2.8.1.1 Product Description: Hellerman Tyton WMB2 or WMB1 depending on application or approved equal, 3 inch x 3 inch front, 2 inch x 5 inch back, mountable in an EIA standard 19 inch rack.

2.8.1.2 Provide two (2) per new installed rack

2.8.1.3 Provide to ITD / Telecommunications for installation.

2.8.1.4 Note: Do Not utilize Horizontal wire management between angle patch panels.

2.8.3 Distribution Rings/Jumper Troughs

2.8.3.1 Product Description: Panduit P110JTW-X or approved equal.

2.8.3.2 Location: On all backboards as required for routing of voice cables in a neat fashion.

2.9 CABLE LADDERS

2.9.1 Product Description: DAMAC PLR1210-3 or approved equal.

2.9.2 Dimensions: 12 inch wide, with side bars 1 inch to 2 inch high.

2.9.3 Provide all hardware, two hole compression style grounding lugs, two hole compression style grounding straps, fasteners, and ladder mounting brackets.

2.10 OPTICAL FIBER ENCLOSURES AND COUPLER PANELS

2.10.1 Product Description: Ortronics ORFC03UC, or approved equal, 2-rack space, Fiber Optic rack mount enclosure (LIU), loaded with all necessary adapter panels for multi-mode and single-mode terminations respectively.

2.10.2 Note: Fiber applications are project specific.

2.11 OPTICAL FIBER CONNECTORS

2.11.1 Product Description: Superior Essex W4012J101 or approved equal for LC or approved equal for single-mode, epoxy/polish, type. Color code fiber optic connectors to meet industry standards.

2.11.2 Quantity: Terminate all strands.

2.12 PATCH PANEL

2.12.1 Product Description: Ortronics ORSPKSU48 TIA/EIA 568B, UL 1863 compliant,

2.12.2 Provide enough patch panel ports for an additional 20 percent. All spare ports must be labeled as SPARE. No more than four (4) Data Patch Panels will be mounted to a 7 ft Equipment Rack. Angled patch panels will be mounted without horizontal wire mangers. If more than four (4) angled patch panels are needed to completer the project or provide for the additional 20 percent growth then additional racks will need to be installed to meet the 4 patch panel per rack standard.

2.13 VOICE CROSS-CONNECT

2.13.1 Product Description: TIA/EIA 568B Ortronics OR-30200145 or approved equal, category 5E wall-mounted assembly of 110 Frames with legs and with adequate capacity for active circuits and space for an additional 20 percent. All voice cables to be terminated 568A standard pertaining to pin sequence configuration.

2.14 INNERDUCT

2.14.1 Manufacturers:

2.14.1.1 Carlon

2.14.1.2 Pyramid

2.14.1.3 Approved equal

2.14.2 Product Description: 1.25 inch inside diameter crush-resistant orange inner-duct, plenum rated if required, with pull rope or pull tape. Innerduct is to be one continuous section with no splices. Duct shall be secured every 20 ft to prevent excess movement.

2.15 COPPER BACKBONE CABLE

2.15.1 Product Description: TIA/EIA 568B, BICC General, 25-pair, category 3, CMP, p/n 231505, or approved equal, 24 AWG annealed copper conductors twisted into pairs of varying lengths and colors coded to telephone industry standards. Plenum rated if required.

2.16 SPECIALTY CIRCUITS CABLE

2.16.1 Product Description: TIA/EIA 568B, BICC General, 25-pair, category 5, CMP, p/n xxxxxx, or approved equal, 24 AWG annealed copper conductors twisted into pairs of varying lengths and color coded to telephone industry standards. Plenum rated if required.

2.17 OPTICAL FIBER BACKBONE CABLE

2.17.1 Product Description: BICC General p/n TIA/EIA 568B, 50 micron, multi-mode, 8.3 physical diameter/9.2 Mode Field Diameter/125μ single-mode as specified.

2.17.2 6-strand Single-mode p/n AP0061PNU and 6-strand Multimode p/n BG0061PNU, or approved equal. Plenum rated if required.

2.18 VOICE HORIZONTAL CABLE

2.18.1 Product Description: TIA/EIA 568B General Cable, GenSpeed 5350, or approved equal, category 5E, balanced twisted pair cable, CMR/CMP plenum rated if required with 4 pairs, 24 AWG copper conductors. All horizontal cables must be from one manufacturer, and preferably from the same lot. No less than

10 ft service loops at the station end and 5 ft at the patch panel end with each installed run.

2.18.2 Color: gray

2.19 DATA HORIZONTAL CABLE

2.19.1 Product Description: TIA/EIA 568B General Cable, Gen Speed 6500, or approved equal, category 6, balanced twisted pair cable, CMR/CMP plenum rated if required with 4 pairs, 24 AWG copper conductors. All horizontal cables must be from one manufacturer, and preferably from the same lot. No less than 10 ft service loops at the station end and 5 ft at the patch panel end with each installed run.

2.19.2 Color: yellow

2.20 CATV HORIZONTAL CABLE

2.20.1 Product Description: Belden RG6 Plenum rated if required cable, or approved equal. Leave 15 ft slack at each end and terminate with F Style Connectors (non cable deforming connectors, “Snap and Seal”).

2.21 COMMUNICATIONS OUTLETS

2.21.1 Product Description: Conform to TIA/EIA 568B requirements for cable connectors for specific cable types, and conform to UL 1863 standard.

2.21.2 Ivory flush wall plate with capacity for two jacks, Ortronics ORKSSMB2 or approved equal. Provide blanks for unused spaces, Ortronics ORKSB1099 or approved equal.

2.21.3 IP Voice and wall data ivory insert jacks, Ortronics ORKS613 one 8 pin non-keyed modular jacks, TIA/EIA 568A category 5E, or approved equal with wire range of 22 to 24 AWG. Pin sequence must be TIA/EIA-568A. Color code ivory and label jacks "V1".

2.21.4 Data for WAPs green insert jacks, Ortronics ORKS645, quantity as indicated, 8 pin non-keyed modular jacks, TIA/EIA 568B category 6, or approved equal with wire range of 22 to 24 AWG. Pin sequence must be TIA/EIA-568-B. Color code orange and label jacks "D1", "D2", “D3”, etc., as applicable.

2.22 PATCH CORDS

2.22.1 Provide Category 6, Data Patch Cords, Quiktron or approved equal for 50 percent of all data connections.

2.22.2 Provide 10 ft, Quicktron 576-110-010 blue for workstation use and closet use.

2.22.3 Provide Duplex Fiber Optic Patch Cords, Allen Tell Products, or approved equal, 50 micron for Multi-Mode fiber connectivity.

2.22.4 Provide XX ea, 2 meters in length, LC to LC, Duplex fiber jumpers, Allen Tell Products, or as required for specific project notes.

2.23 CABLE SUPPORTS

2.23.1 Manufacturers:

2.23.1.1 Caddy

2.23.1.2 Erico

2.23.1.3 Approved equal

2.23.2 Product Description: Wide Base J hooks or Cable Slings mounted to independent ceiling wires for smaller cable pathways. Clips must comply with UL, CUL, CEC and TIA/EIA requirements for structured cabling systems. See drawing details. Each low voltage system shall have its own independent support system. (Do not use security system, CCTV, fire, hangers etc.)

2.24 SLEEVES

2.24.1 Product Description: Fire Rated Walls must be penetrated with STI EZ-PATH ™ Brand, or approved equal, device modules comprised of steel raceway with intumescent foam pads allowing 0 – 100 percent cable fill. Unrated walls may be penetrated with 4 inch conduit sleeves, provided with draft stop material. Refer to Section 260583.

2.25 CABLE LABELS

2.25.1 Manufacturers:

2.25.1.1 Ortronics

2.25.1.2 Approved equal

2.25.2 Product Description: wrap-around smoke rated labels, neatly hand written or printed by a mechanical means.

2.25.3 Alternatively, labels may be neatly handwritten directly on the cable jacket using a fine point indelible ink marker.

2.26 PULL WIRES

2.26.1 All Conduits must have a pull cord installed with a minimum pulling tension of 200 lbs.

2.27 CABLE TIES AND ACCESSORIES

2.27.1 Hook and loop cable wraps, cable clamps, split mesh grips, cable hooks, and cable supports, as required to support the cables and dress the cables in a tidy manner. Hook and loop cable wraps are to utilized for all Cat. 6 and fiber cabling.

2.28 OTHER HARDWARE

2.28.1 Screws, washers, nuts, lugs, bolts, and other hardware required for the proper installation of the cabling system.

PART 3 - EXECUTION

3.1 EXISTING WORK

3.1.1 Ensure access to existing telecommunications equipment, cabling, and terminations and other installations which remain active and which require access. All Existing systems shall be protected from dust and debris, any damage resulting from dust or debris shall be at the expense of the Contractor. Including any cleanup of existing equipment.

3.2 PERFORMANCE

3.2.1 All installation work must be done by qualified / manufacture certified craftspeople in a neat, high quality manner and must conform to the most stringent of applicable local, state, federal building codes, and referenced standards.

3.2.2 Contractor must provide a project manager who has demonstrated the ability to supervise a project of this magnitude.

3.2.3 Ceiling tiles broken or defaced by the Contractor during the installation and testing process must be replaced at the expense of the Contractor.

3.2.4 Contractor will be responsible for all freight charges related to materials purchases. Failure to order materials in a timely manner resulting in added freight charges or availability issues would not be considered a valid reason to substitute materials.

3.3 INSTALLATION

3.3.1 Install termination backboards and racks plumb, and attach securely to building wall at each corner.

3.3.2 Telephone Backboard must be configured in a manner that places telephone blocks on the left hand side and feed blocks on the right hand side of the board, or in a manner that has been preapproved by County Telecommunications Staff. Adequate wire management distribution rings must be place in an arrangement

to allow wire cross connect jumpers to be placed on all blocks. Feed, distribution, and station cabling must enter termination blocks from the bottom of the backboard and be routed from the side of backboard.

3.3.3 Finish paint termination backboards with durable enamel matching interior color prior to installation of telephone equipment taking care not to paint over laboratory fire listing label.

3.3.4 Brace each rack to the concrete floor below. Detail the method of fastening to the floor on shop drawings. All racks will be fastened to the floor using flush mount, drop-in anchors. Do not use stud insert type anchors.

3.3.5 Securely fasten the ladder sections to each other, to the walls, and top of the equipment racks utilizing manufactured adapter plates and J-hooks. All connections to the walls shall be structural in nature.

3.3.6 Ground and bond pathways, cable shields, and equipment as shown and specified herein.

3.3.6.1 Install bonding backbone system without splices in accordance with TIA/EIA 607/942 using two hole compression type lugs, providing warning tags for each cable as close as possible to the point of termination, secured with nylon cable ties. Both bolts will be installed to secure grounding lugs to ground bus bar.

3.3.6.2 Install grounding lugs and straps to ground the sections of ladder to each other utilizing threaded bolts, washers and nuts. Paint on the racks and ladders shall be removed so as to facilitate metal to metal contact for grounding, an alternate method shall be to utilize paint piercing washers to make metal to metal contact (Star Washers).

3.3.6.3 Ground the sleeves, cable trays, ladders, and relay racks to the Telecommunications Grounding Bus bar located in the room with 6 AWG. (THHN) green in color Wire.

3.3.6.4 Individually and properly ground all equipment cabinets, racks and inside and outside plant cable shields, wherever the cables leave the sheaths, to the (TMGB) Telecommunications Main Grounding Bus.

3.3.6.5 Daisy chaining of Ground cabling from equipment is not permitted.

3.3.6.6 All bonding conductors must have green insulation, or be identified with green tape. Provide warning tags for each bonding conductor as close as possible to the point of termination, secured with nylon cable ties.

3.3.6.7 All data patch panels must be bonded to the rack with separate bonding wire no less than 14 AWG, or per manufacturer’s instructions.

3.3.6.8 Ensure that grounding lugs make a metal-to-metal contact with all equipment racks, cable trays, ladders and ground sleeves. Remove paint from surfaces as needed.

3.3.7 Install pathways in accordance with TIA/EIA 569-A.

3.3.7.1 Cable clamps or supports are needed for riser backbone cables. Cable hooks are required for horizontal cabling.

3.3.7.2 Install clips to provide strain relief and route cables so bend radius conforms to TIA/EIA 568B standard.

3.3.7.3 Contractor will be responsible for engineering quantities of and installing any necessary wire basket, flexible metal tray, J-hooks and/or cable slings for routing cables in ceiling space. Flexible cable management tray must be supported per manufacturers' instructions. They should also be placed at every drop point such as conduit stub-up, without exception, and wherever support is needed to avoid sagging or to avoid touching piping, ducting or other trades' work. Attaching or draping cables to ceiling wire grid, other pipes, light fixtures, etc., will not be permitted. Rather Contractor must provide separate ceiling wire for securing J-hooks. Use of the ceiling grid wire installed by others is not permitted.

3.3.7.4 All sleeves must be fire proofed as required. Seal all sleeves after cabling has been tested and approved. All empty sleeves must be sealed.

3.3.7.5 Replacement pull ropes must match the original pull ropes installed in the inter-ducts.

3.3.8 Install wire and cable in accordance with TIA/EIA 568B.

3.3.8.1 Install cable directly from box/spool, without allowing slack to coil up on floor.

3.3.8.2 Cables must be placed with sufficient bending radius so as not to kink, shear, or damage jackets, binders or cables, including where cables are coiled for future use or slack. Bending must not exceed manufacturers' specified bend radii. Cable must not be wrapped around the feet of systems furniture.

3.3.8.3 All Fiber Optic Cable must be installed inside Inter-duct.

3.3.8.4 Tie wraps are not permitted for securing or bundling cables of category 6 or higher. Provide hook and loop wraps for bundling of cables.

3.3.8.5 No more than fifty feet of outside plant cable is allowed inside the building. Ground armor at point of entry into the building. All Outside Plant cable will be terminated onto a County approved building entrance protector.

3.3.8.6 All exterior conduits shall be sealed utilizing approved putty or sealer to prevent animal and water intrusion into space.

3.3.8.7 When installing cables in conduits with pull-strings, replace pull-strings used with new ones.

3.3.8.8 In no event must any horizontal cables be spliced between telecomm rooms and workstations.

3.3.8.9 No horizontal cable runs less than fifty feet in length will be permitted.

3.3.8.10 Fiber optic cable to have 30 ft service loops prior to entry into Fiber Optic Enclosures. Neatly coil and secure service loops on nearest wall prior to entering rack or cabinet.

3.3.8.11 Horizontal station cabling must have no less than 10 ft service loops at the station end and 5 ft at the patch panel end. In the case of home run conduit utilization all slack (15 ft) will be coiled at the back board end after approval by Telecommunications staff as to design.

3.3.8.12 In cubicle workstation locations, each workstation area will have two (2) communication furniture faceplates if more than four cables are indicated on drawings. The faceplates will be separated with as shown on the drawings. All cubicle furniture faceplates will require faceplate extenders.

3.3.9 The Contractor must ensure that all floor and wall penetrations will be fire-stop rated to the satisfaction of County Telecommunications and as required by applicable codes. Provide fire stop, after cables have been installed, tested and documented.

3.4 LABELING

3.4.1 Building Backbone Cable Labeling Scheme:

3.4.1.1 Building backbone cables are to be labeled at both ends in compliance with the TIA/EIA 606-A Standard.

3.4.1.2 Cable must be identified with the following:

3.4.1.3 Building number (Provided by County Telecommunications)

3.4.1.4 Terminating IDF number

3.4.1.5 Cable number within group of cables starting and ending in the same rooms as the cable being identified.

3.4.2 Mark the ends of the cable every 24 inch for 4 feet

3.4.3 Horizontal Link Labeling Scheme:

3.4.3.1 Horizontal cables are to be labeled at both ends in compliance with the TIA/EIA 606-A Standard. The punch down blocks/patch panels, and face of the workstation outlets must be labeled with machine labels.

3.4.3.2 Cable must be identified with the following:

3.4.3.3 Building number (Provided by County Telecommunications)

3.4.3.4 Closet number or telecommunications Backboard number

3.4.3.5 Station number

3.4.3.6 Jack number

Jack Designator:

Color:	Use:	Designation:
Ivory	Voice 1	V1
Ivory	Data 1	D1
Ivory	Data 2	D2
Ivory	Data 3	D3
Green	WAP 1	W4
Green	WAP 2	W5

3.4.3.7 An example of a cable label is shown on the drawings. Final outlet and block labeling methods to be approved by County Telecommunications Staff before labeling is done on outlets and blocks.

3.4.3.8 Mark the ends of the cable every 12 inch for 4 feet. All workstation outlets must be labeled as identified per the drawings.

3.4.3.9 All Labeling at workstation and patch panel ends shall be completed prior to testing.

3.4.3.10 Voice Termination Frames must have Blue Designation Strips.

3.4.3.11 Data Patch Panels must have White Designation Labels.

3.4.3.12 Label all Horizontal Fiber Optic Cable/Innerduct every 50’ in open areas with Manufactured Fiber Optic Caution Warning Tags labels shall state fiber count, to and from designators and date of installation.

3.4.3.13 All voice frames and data patch panels must be numbered sequentially in a non- recurring manner. Numbering must include building number/backboard designator, plus station number starting at 1 and continue to the highest number required. All stations must be numbered at their termination ends by a machine made label and attached to the faceplate.

3.4.3.14 Voice Termination Frame numbering must start at the upper left hand corner of the termination block and proceed from left to right, top to bottom of block sequentially. Data Patch Panel numbering must start at the upper left-hand corner of the panel and proceed from left to right and top to bottom sequentially.

3.5 CONDUITS

3.5.1 All conduits for communications cables must:

3.5.1.1 Have an approved pull wire with a minimum pulling tension of 200 lbs.

3.5.1.2 Be properly reamed at both ends.

3.5.1.3 Have grounding bushings or hubs at both ends for exterior metal conduits.

3.5.1.4 Be grounded as required by local codes and ordinances.

3.5.1.5 Be rigidly installed and properly supported.

3.5.1.6 Be left clean, dry, and free of debris or other obstructions.

3.5.1.7 Must have a 12 AWG copper tracer wire attached to conduit for externally routed PVC conduit. Where tracer wire runs parallel to conduit route. Tracer wire shall be accessible at each end of conduit path.

3.5.2 Pull boxes for conduits supporting horizontal cables must be installed by the Electrical Contractor when one of the following conditions has occurred:

3.5.2.1 The conduit run is over 100 feet, or as shown on engineering prints.

3.5.2.2 There are more than two 90 degree bends, or

3.5.2.3 There is a reverse bend in the conduit run.

3.5.3 Boxes must be in a straight section of conduit and not used in lieu of a bend. Conduits must be aligned on opposite ends of the pull box. Entering in at the end of the box NOT in the middle from below the minimum size pull boxes must be based on the conduit size as follows:

Conduit Trade Size	Width	Length	Depth
3/4"	12"	12"	12"
1"	12"	16"	12"
1 1/4"	12"	22"	12"
1 1/2"	13"	24"	12"
2"	17"	30"	12"
2 1/2"	20	42"	12"

3"	20"	42"	12"
3 1/2"	30"	48"	24"
4"	30"	60"	24"

3.5.4 Pull boxes must be provided with internal wall rack assemblies to support cabling.

3.5.4.1 Pull box lids will be of the bolt down or locking type if required and constructed of the same material as the box with exception to traffic rated applications.

3.6 TESTING

3.6.1 All copper and fiber cables must be tested utilizing the proper category rated tests.

3.6.2 All horizontal cables, outlets and terminations must meet or exceed all performance specifications designated by ANSI, TIA/EIA 568B2-1, and IEEE.

3.6.3 All fiber optic cabling must be tested end-to-end for overall db loss at 850nm ad 1300 nm for multi-mode and 1310 nm and 1550 nm for single-mode in both directions. Fiber Optic Connector db loss must be 0.5 or less.

3.6.4 Testing and labeling must be completed, with test results presented to the Owner no later than three (3) days prior to project completion.

3.6.5 Testing of the permanent link as defined by TIA/EIA 568B2-1, and including the horizontal cable, outlet, and patch panel or wiring block, must include end-to-end tests, 2-way testing using a tester calibrated daily, meeting TSB-67 for Accuracy Level III for Permanent Link, and will be equipped with appropriate report software for turning raw test data into finished reports.

3.6.6 Contractor will use tester and software to provide test results deliverable on a compact disk or 3.5 inch diskette in an approved electronic format as well as in a written format. Information will include the following:

3.6.6.1 Opens

3.6.6.2 Shorts

3.6.6.3 Grounds

3.6.6.4 Continuity

3.6.6.5 Polarity, or pair reversals

3.6.6.6 DC Loop resistance

3.6.6.7 Impulse noise

3.6.6.8 Signal attenuation at 200 KHz to 350 MHz in 100 KHz increments

3.6.6.9 Insertion loss @ 200 KHz to 350 MHz in 100 KHz increments

3.6.6.10 NEXT (near-end cross talk) @ 200 KHz to 350 MHz in 100 KHz increments

3.6.6.11 Station cable length/overall loops resistance.

3.6.6.12 Ambient Noise.

3.6.6.13 Attenuation to Cross-Talk Ratio (ACR).

3.6.6.14 Propagation Delay

3.6.6.15 Delay Skew

3.6.7 Any cables failing to meet above indicated standards must be removed and replaced, at no cost to the Owner, with cables that prove, in testing, to meet the standards. The installation will not be accepted until testing has reported that all pairs in all cables meet the appropriate standards.

3.7 EXAMINATION/FIELD QUALITY CONTROL

3.7.1 On a daily basis, the Contractor's project manager will inspect the installation to ensure that installers are following the specifications and quality craftsmanship.

3.7.2 The County Telecommunications Division. Reserves the right to inspect the installation at any time. If the County or County's representative makes a change to the design or installation, this change must be noted in writing. The contractor shall not complete this change until approval is given by the County's Telecommunications' administrator in writing. Through the project management process.

3.7.3 After installation, the County Telecommunications representative will inspect the site and prepare a closeout punch list for the contractor to complete.

3.7.4 After the completion, the County Telecommunications representative and contractor will inspect the site together.

3.8 CLEANING

3.8.1 At the end of each work day, the Contractor will clean up waste and remove from the site or in a designated container approved by the Owner. Excess materials shall be stored in a limited access area.

3.8.2 After punch list is complete, the Contractor will clean/dust racks, cabinets and faceplates. Contractor should broom clean the telecommunication closet floor of all wiring pieces, tape and refuse.

3.9 DOCUMENTATION

3.9.1 Horizontal Cable Records: The Contractor must provide a database of cable records in compliance with the TIA/EIA 606-A Standard, both hard copy and on floppy or CD- ROM disk, using County Telecommunications approved DBMS format for input to County's facilities management package (to be determined). The cable records format must include at least the following information about each cable:

3.9.1.1 Cable identifier

3.9.1.2 Cable type

3.9.1.3 Type of terminating hardware at the start of the cable

3.9.1.4 Type of terminating hardware at the end of the cable

3.9.1.5 Riser/backbone or distribution cable pair assignments

3.9.1.6 Test results

3.9.2 Project Documentation: The following are required to be submitted immediately upon completion of testing and labeling of System. They will be used by the County for making data and voice equipment connections to the System:

3.9.3 Reproducible (such as vellums, mylars and AutoCAD diskette files) as-built drawings showing locations of all technology outlets, cable location numbers, type of cabling installed for backbone and workstations, main cable pathways, cable tray, ladder rack, sleeves, firestopping, grounding busbars, and cable supports. Provide two (2) sets of Xerox copies and a CD Rom Disk using AutoCAD 2004 or newer version.

3.9.4 Test results will be neatly organized in a 3-Ring Binder(s).

3.9.5 Contractor will provide full size laminated telecommunications cable distribution floor plan complete with jack numbers, furniture locations and post in the Main Telecommunications Closet.as part of acceptance and prior County occupancy.

3.9.6 Manuals of operation and training, as required.

3.10 WARRANTY

3.10.1 Contractor must fully warrant proper operation of installed system and components for a minimum of 20 years after system turnover to County. The Contractor must provide a Panduit "performance" level warranty. Refer to Section 3.9 Documentation for delivery instructions.

3.11 OUTSIDE UTILITY SERVICE

3.11.1 Contractor must adhere to outside utility minimum specified requirements for trenching, conduit, boxes and manholes, aerial entrance masts, service cabinets, bonding and grounding. This includes requirements for approval of design plans prior to service installation.

3.12 GENERAL NOTES AND REQUIREMENTS

3.12.1 Substitutions of material or product must be approved by County Telecommunications' Staff prior to award of low voltage contractor. All correspondence shall be in writing following the project management process.

3.12.2 General contractor shall be responsible for verification of subcontractor's compliance to base bid specifications. County shall not be held responsible for subcontractor's non compliance with specification requirements as listed in this document.

3.12.3 This specification document supersedes any drawing or bid document unless otherwise approved by County Telecommunications Staff In writing.

END OF SECTION

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

1.1.1 This section covers the requirements for the extension of the following system: Intercom/Paging, Clock, Intrusion, and Telephone Cabling. Furnish and install all equipment, components, accessories and materials in accordance with these specifications and drawings for the extension of these systems. The system components include speakers, clocks, motion sensors, clocks, outlets, devices, wiring, etc. and all accessories and modules necessary at the existing systems "headend" for the extensions. All components shall be compatible and match the existing systems.

1.1.2 The existing intercom/paging system is the Rauland ICS.

1.1.3 The existing intrusion system is Honeywell/Ademco Vista.

1.1.4 The existing master clock system is the Rauland ICS.

1.2 RELATED DOCUMENTS

1.2.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2.2 Requirements of the following Division 26 Sections apply to this Section:

1.2.2.1 Basic Electrical Requirements - Section 26 00 00.

1.2.2.2 Basic Electrical Materials and Methods - Section 26 05 00.

1.3 SUBMITTALS

1.3.1 General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

1.3.1.1 Submit equipment prints, inter-panel and intra-panel, full electronic wiring diagrams and specification sheets for each item specified herein. Specification Sheets shall be submitted on all items including cable types.

1.3.1.2 Shop drawings.

1.3.1.3 Wiring diagrams, detailing wiring for power, signal, and control, differentiating clearly between manufacturer -installed wiring and field installed wiring. Identify terminals to facilitate installation, operation and maintenance.

1.3.1.4 Submit wiring diagrams showing typical connections for all equipment.

1.3.1.5 Provide a riser diagram for the system showing in technically accurate detail all connections, interconnections, and all provisions available and made for adaptability of all specified future functions and including all calculations, charts, and test data necessary to demonstrate that all systems and system components deliver the specified signals, grades, and levels at all required points and locations.

1.3.1.6 Submit a certificate of completion of installation and service training.

1.4 QUALITY ASSURANCE

1.4.1 All items of equipment including wire and cable shall be designed by the manufacturer to function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.

1.4.2 The Contractor shall be an established communications and electronics contractor that has had and currently maintains a locally run and operated business for at least five (5) years. The Contractor shall utilize a duly authorized distributor of the equipment supplied for this project location with full manufacturer's warranty privileges.

1.4.3 The Contractor shall show satisfactory evidence, upon request, that the supplier maintains a fully equipped service organization capable of furnishing adequate inspection and service to the system. The supplier shall maintain at his facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.

1.4.4 Electrical Component Standard: Provide work complying with applicable requirements of the California Electrical Code (CEC) including, but not limited to:

1.4.4.1 Article 250, Grounding.

1.4.4.2 Article 300, Part A. Wiring Method.

1.4.4.3 Article 310, Conductors for General Wiring.

1.4.4.4 Article 725, Remote Control, Signaling Circuits.

1.4.4.5 Article 800, Communication Systems.

1.4.5 The agency providing equipment shall be responsible for providing all specified equipment and mentioned services for all equipment as specified herein.

1.4.6 The supplier shall visit the sites and familiarize himself with the existing conditions and field requirements prior to submitting a proposal.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Deliver products in factory containers. Store in clean, dry space in original containers. Protect products from fumes and construction traffic. Handle carefully to avoid damage.

PART 2 - PRODUCTS

2.1 MANUFACTURER

2.1.1 New system components shall be compatible with their respective systems.

2.1.2 All end-to-end components of a system shall be manufactured by a single manufacturer or consortium so as to establish a complete, warrantable solution by the manufacturer.

2.2 CLOCKS, SPEAKERS AND ENCLOSURES

2.2.1 Clocks, speakers and enclosures shall match the existing Rauland system.

2.2.2 All units shall be recessed except that surface units can be used where construction does not allow recess mounting and where allowed by the Architect.

2.3 CLOCKS

2.3.1 Match existing Rauland Clocks.

2.4 INTRUSION

2.4.1 Provide PIR type motion sensors to match existing type, wall mounted with Gymbal.

2.4.2 Door contact switches to match the existing system.

2.5 TELEPHONE

2.5.1 Telephones shall match the existing system. Coordinate with school district for model number.

2.6 TELEPHONE CABLING

2.6.1 The horizontal cable shall be 4-pair Category 6 UTP; CMR rated (minimum), or CMP rated where required by code, and shall meet ANSI/TIA Commercial Building Telecommunications Wiring Standards for horizontal wire.

2.6.2 The station cable will terminate on 19 inch rack-mounted panels. The twists and the outer jacket of all cables shall be maintained within ¼ inch of the termination point.

2.6.3 Provide a RJ45 type Category 6 8-pin modular jack at the station end of all 4 pair cables. All jacks will use the ANSI/TIA T568B wiring configuration. Provide modular jack wallplates in Keystone (QuickPort) format. Use common wallplates with data jacks where applicable.

2.6.4 Twisted Pair Entrance and Distribution Cable: All twisted pair entrance cables shall be Category-3, 22 gauge, twisted pairs. They shall comply with UL and CEC Article 800 requirements. Indoor cable shall be rated for the environment, CM for non plenum/riser areas and CMP for riser and plenum areas. Outdoor cable shall be suitable for direct burial, OSP type.

2.6.5 Terminate Entrance and Distribution cables on 110 blocks with legs or patch panels on rack. Provide cross connect cabling infrastructure from wall blocks to station cable patch panels.

2.7 MISCELLANEOUS

2.7.1 For all systems, provide peripheral devices and accessories as needed to meet systems' needs. This includes power supplies, relays, modules, cards, etc. Provide reprogramming of systems as necessary, coordinated with the Owner. Provide necessary wiring.

2.7.2 Power supplies to be UL Listed for Class 2 systems.

PART 3 - EXECUTION

3.1 EXAMINATION

3.1.1 Examine conditions, with the Installer present, for compliance with requirements and other conditions affecting the performance of the programmable electronic communications network system work.

3.1.2 Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

3.2.1 General: Install system in accordance with the CEC and other applicable codes. Install equipment in accordance with manufacturer's written instructions.

3.2.2 Wiring Methods: Install wiring in raceway except within consoles, desks, and counters, and except in accessible ceiling spaces, and in gypsum board partitions, where cable wiring method may be used. Use UL listed plenum cable in environmental air spaces including plenum ceilings. Conceal wiring except in unfinished spaces.

3.2.3 Impedance and Level Matching: Carefully match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.

3.2.4 Control Circuit Wiring:

3.2.4.1 Install control circuits in accordance with NFPA 70 and as indicated. Provide number of conductors as recommended by system manufacturer to provide control functions indicated or specified.

3.2.4.2 All wires shall be laid down on terminal panels and identified by the actual room location it serves. All the communications points shall be wired into this main distribution frame, laid down in sequence, and identified by which line it is on and the point position it serves.

3.2.4.3 All housings are to be located as specified and shown on drawings.

3.2.4.4 Make installation in strict accordance with approved manufacturer's drawings and instructions.

3.2.4.5 The Contractor shall provide necessary transient protection for all station lines leaving or entering the building, and all central office trunks. All protection shall be as recommended by the equipment supplier and referenced to earth ground.

3.2.5 Wiring within Enclosures: Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.

3.2.6 Splices, Taps, and Terminations: Make splices, taps and terminations on numbered terminal punch blocks in junction, pull, and outlet boxes, terminal cabinets and equipment enclosures.

3.2.7 Identification of Conductors and Cables: Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams.

3.2.8 Weatherproofing: Provide weatherproof enclosures for items to be mounted outdoors or exposed to weather.

3.2.9 Repairs: Wherever walls, ceilings, floors, or other building finishes are cut for installation, repair, restore, and refinish to original appearance.

3.3 GROUNDING

3.3.1 Ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

3.3.2 The Contractor shall provide all necessary transient protection on the AC power feed and on all station lines leaving or entering the building.

3.3.3 The Contractor shall note in his system drawings, the type and location of these protection devices as well as all wiring information.

3.4 FIELD QUALITY CONTROL

3.4.1 Manufacturer's Field Services: Provide services of a duly factory authorized service representative for this project location to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

3.4.2 Inspection: Make observations to verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Provide a list of final tap settings of paging speaker line matching transformers.

3.4.3 Testing: Rectify deficiencies indicated by tests and completely retest work affected by such deficiencies at Contractor's expense. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

3.5 COMMISSIONING

3.5.1 Provide system start-up, training to Owner's maintenance and administrative personnel for the system extensions. Familiarize personnel with new stations, operating procedures, etc.

3.5.2 Provide O & M manuals for new system components. O & M manuals shall include the approved shop drawings and submitted equipment.

3.5.3 Occupancy Adjustments: When requested by the Architect within one (1) year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, resetting matching transformer taps, and adjusting controls to suit actual occupied conditions.

3.6 CLEANING AND PROTECTION

3.6.1 Prior to final acceptance, clean system components and protect from damage and deterioration.

END OF SECTION