KLING STUBBINS

ARCHITECTURE
ENGINEERING
INTERIORS
PLANNING

Pennsylvania Convention Center Authority

Pennsylvania Convention Center Renovation

Project Manual - Main Building Upgrade – Technology Systems

Issued for Construction, April 29, 2011

Project Number 87-5979-03

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SPECIFICATIONS LIST

O = Original Issue
REV = Revised
Blank = Future Issue
DEL = Deleted

		Issued for Construction, 4/29/11			
Division 00 - Procurement and Contracting Requirements					
00001	Specifications List	O			
Division 01 - General Requirements					
010100	Summary of Work	O			
013410	Submittal Register	O			
	Balance of Sections by Owner				
Division 02 through 07					
Not Used					
Division 08 - Openings					
081416	Flush Wood Doors	O			
087100	Door Hardware	O			
Division 09 through 25					
Not Used					
Division 26 - Electrical					
260500	Common Work Results for Electrical	O			
260519	Low-Voltage Electrical Power Conductors and Cables	O			
260526	Grounding and Bonding for Electrical Systems	O			
260529	Hangers and Supports for Electrical Systems	O			
260533	Raceway and Boxes for Electrical Systems	O			
260536	Cable Trays for Electrical Systems	O			
260553	Identification for Electrical Systems	O			
263353	Uninterruptible Power Supply (UPS) Systems (Stand Alone)	O			

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		Issued for Construction, 4/29/11			
Division 27 - Communications					
270500	Common Work Results for Communications	O			
271100	Communications Equipment Room Fittings	O			
271500	Communications Horizontal Cabling	O			
274100	Audiovisual Systems	O			
Division 28 - Electronic Safety and Security					
281600	Security System	O			
Division 31 through 48					
Not Used					

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Construction operations required by Contract Documents, defines aspects of Contractor's relationship with Owner and Design Professional, and lists special Owner requirements.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Divisions 00 & 01.

B. Common Work Results for Electrical: Division 26.

C. Communications Equipment Room Fittings: Division 27.

D. Communications Horizontal Cabling: Division 27.

E. Audiovisual Systems: Division 27.

1.3 Project Description

A. Work Includes: Renovation, replacement and Construction of audiovisual, security systems and network infrastructure for the Pennsylvania Convention Center located in Philadelphia, PA. Work consists of, but not limited to, the following:

1. Furnish and Install Audiovisual (AV) systems including AV equipment upgrades as specified including existing AV Master Control Room equipment, Amplifier Rooms equipment, and other equipment and systems indicated. Meeting Room Monitors, Digital Media Players, backboxes, hangers and associated cabling will be supplied and installed by others
2. AV systems interface with the building FA system to support emergency paging.
3. Modify to and re-route existing power distribution circuits to existing AV audio amplifiers and equipment to connect it to the new UPS systems.
4. Furnish attic stock to the Owner at completion of the project, as specified.

1.4 Contracts

A. Construct Work under a single lump sum Contract.

1.5 Work By Others

A. Related Work which shall be executed prior to start of or during time of Construction of Work of this Contract and which is excluded from this Contract:

1. Work shown or indicated to be a part of Contract 11-03.

B. Contractor's Work:

1. Coordinate delivery dates with other Work.
2. Promptly inspect delivered products for damaged or defective items.
3. Unload and handle delivered products at Project Site, including uncrating and storage.
4. Protect delivered products from exposure to elements and from damage.
5. Repair or replace items damaged as a result of Contractor's operations.
6. Install and connect delivered products.

1.6 Contractor’s Use Of Premises

A. Contractor shall limit use of premises for Work and for storage to allow for:

1. Work of other Contractors.
2. Owner Occupancy.
3. Public Use.

B. Coordinate use of premises under direction of Construction Manager.

C. Protect products furnished to and stored on Project Site.

D. Move stored products to avoid interference with operations of Owner and other Contractors.

E. Do not overload structure with stored materials.

1.7 Owner Occupancy

A. Owner will occupy areas for purposes of Owner’s business operations.

B. Provide for Owner's use:

1. Access for employees.
2. Availability of necessary utilities.

C. Prior to occupancy by Owner, execute Certificate of Substantial Completion for Area of Occupancy.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

In addition to the requirements for submissions as specified under Division 01 Contractor shall submit to Design Professional (DP) for review and to Owner for record, those items indicated by an "X". In the event of discrepancies between this Section and requirements in individual Specification Sections, the requirements of Specification Section shall govern.

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
081416	**FLUSH WOOD DOORS:**		
	Product Data	X	
	Shop Drawings	X	
	Samples for Initial Selection	X	
	Samples for Verification	X	
	Warranty		X
087100	**DOOR HARDWARE:**		
	Product Data	X	
	Shop Drawings	X	
	Product Certificates		X
	Qualification Data		X
	Maintenance Data		X
	Warranty		X
	Other Action Submittals:		
	Door Hardware Groups	X	X
	Keying Schedule	X	X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
260500	**COMMON WORK RESULTS FOR ELECTRICAL**		
	Product Data	X	
260519	**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES:**		
	Product Data	X	
	Qualification Data		X
	Field Quality-Control Test Reports		X
260526	**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS:**		
	Product Data	X	
	Informational Submittals		X
	Qualification Data		X
	Operation and Maintenance Data		X
260529	**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS:**		
	Product Data	X	
	Shop Drawings	X	
	Welding Certificates		X
260533	**RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS:**		
	Product Data	X	
	Shop Drawings	X	
	Coordination Drawings	X	
	Qualification Data		X
	Source Quality-Control Test Reports		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
260536	**CABLE TRAYS FOR ELECTRICAL SYSTEMS:**		
	Product Data	X	
	Shop Drawings	X	
	Coordination Drawings	X	
	Field Quality-Control Reports		X
	Operation and Maintenance Data		X
260553	**IDENTIFICATION FOR ELECTRICAL SYSTEMS:**		
	Product Data	X	
	Identification Schedule	X	
263353	**UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEMS (STAND ALONE):**		
	Shop Drawings	X	
	Product Data	X	
	Quality Control Procedures		X
	Certifications		X
	Closeout Submittals		X
270500	**COMMON WORK RESULTS FOR COMMUNICATIONS:**		
	Closeout Submittals		X
271100	**COMMUNICATIONS EQUIPMENT ROOM FITTINGS:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Informational Submittals:		
	Qualification Data		X
	Closeout Submittals		X
271500	**COMMUNICATIONS HORIZONTAL CABLING:**		
	Product Data	X	
	Samples	X	
	Shop Drawings	X	
	Closeout Submittals		X
274100	**AUDIOVISUAL SYSTEMS:**		
	Shop Drawings	X	
	Product Data	X	
	Samples	X	
	Test Reports		X
	Operation and Maintenance Data		X
281600	**SECURITY SYSTEM:**		
	Shop Drawings	X	
	Product Data	X	
	Closeout Submittals		X

END

Section 081416 Flush Wood Doors

Part 1 General

1.1 Related Documents

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

1.2 Summary

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Sections:

1. Division 08 Section "Door Hardware".
2. Division 28 Section “Security System”.

1.3 Submittals

A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire-protection ratings for fire-rated doors.

C. Samples for Initial Selection: For factory-finished doors.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

2. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.

   a. Provide samples for each species of veneer and solid lumber required.
   b. Finish veneer-faced door samples with same materials proposed for factory-finished doors.

3. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

E. Warranty: Sample of special warranty.

1.4 Quality Assurance

A. Source Limitations: Obtain flush wood doors from single manufacturer.

B. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."

1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.

1.5 Delivery, Storage, And Handling

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 Project Conditions

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and can maintain temperature between 60 and 90 degrees F and relative humidity between 17 and 50 percent for 24 hours preceding the installation of woodwork, during the installation of woodwork, and for the remainder of the construction period until the permanent HVAC system can maintain the temperature and humidity ranges specified, in all spaces to receive woodwork.

1.7 Warranty

A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
    b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.

3. Warranty Period for Solid-Core Interior Doors: Life of installation.

Part 2 Products

2.1 Manufacturers

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

1. Algoma Hardwoods, Inc.

2. Eggers Industries.

3. Marshfield Door Systems, Inc.

4. VT Industries Inc.

2.2 Door Construction, General

A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.

B. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-1.

2. Blocking: Provide wood blocking in particleboard-core doors as follows:

    a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
    b. 5-inch (125-mm) bottom-rail blocking, in doors indicated to have kick, mop, or armor plates.

3. Provide doors with either glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

2.3 Veneered-Faced Doors For Transparent Finish (FF=Factory Finish)

A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade AA faces.

2. Species: Fiddle Back Anigre; to match existing / Sapele; to match Design Professional's sample.

3. Cut: To match existing.

4. Match between Veneer Leaves: Book match.

5. Assembly of Veneer Leaves on Door Faces: Center-balance match.

6. Pair and Set Match: Provide for doors hung in same opening.

7. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.

8. Exposed Vertical Edges: Same species as faces.

9. Core: Particleboard.

10. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.

2.4 Doors For Opaque Finish (FP = Field Paint)

A. Interior Solid-Core Doors:

1. Grade: Custom.

2. Faces: .Ash or Birch veneer.

3. Exposed Vertical and Top Edges: Any closed-grain hardwood.

4. Core: Particleboard.

5. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.

2.5 Fabrication

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings with moldings of material and profile indicated.

2. Glazing: Factory install glazing in doors indicated to be factory finished.

2.6 Shop Priming

A. Doors for Opaque Finish: Shop prime doors with one coat of wood primer. Seal all four edges, edges of cutouts, and mortises with primer.

2.7 Factory Finishing

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

   1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.

C. Transparent Finish:

   1. Grade: Custom.
   2. Finish: AWI conversion varnish or catalyzed polyurethane system.
   3. Staining: Match existing.
   4. Effect: Match existing.
   5. Sheen: Match existing.

Part 3 Execution

3.1 Examination

A. Examine doors and installed door frames before hanging doors.

   1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
   2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

A. Hardware: For installation, see Division 08 Section "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

C. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 Adjusting

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END

Section 087100 Door Hardware

Part 1 General

1.1 Related Documents

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

1.2 Summary

A. This Section includes the following:

1. Commercial door hardware for the following:

   a. Standard Steel Doors.
   b. Wood Doors.

2. Cylinders for doors specified in other Sections.

3. Electrified door hardware.

B. Related Sections include the following:

1. Division 08 Section "Flush Wood Doors".

C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.

1. Pivots, thresholds, weather stripping, and cylinders for locks specified in other Sections.

2. Permanent cores to be installed by Owner.

D. Products not included in this Section, and not installed as Work of this Section:

1. Cabinet hardware.

2. Sign hardware.

3. Rough hardware.

4. Operable Partition Hardware, including Pass Door Hardware.

1.3 Submittals

A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Details of electrified door hardware, indicating the following:

1. Wiring Diagrams: Power, signal, and control wiring. Include the following:

   a. System schematic.
   b. Point-to-point wiring diagram.
   c. Riser diagram.
   d. Elevation of each door.

2. Detail interface between electrified door hardware and fire alarm, access control, security, and building control system.

3. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

C. Product Certificates: For electrified door hardware, signed by product manufacturer.

1. Certify that door hardware approved for use on types and sizes of labeled fire doors complies with listed fire door assemblies.

D. Qualification Data: For Installer and Architectural Hardware Consultant.

E. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

F. Warranty: Special warranty specified in this Section.

G. Other Action Submittals:

1. Door Hardware Groups: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware groups with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

   a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
   b. Content: Include the following information:

      1) Identification number, location, hand, fire rating, and material of each door and frame.

      2) Type, style, function, size, quantity, and finish of each door hardware item. Include description and function of each lockset and exit device.

      3) Complete designations of every item required for each door or opening including name and manufacturer.

      4) Fastenings and other pertinent information.

      5) Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.

      6) Explanation of abbreviations, symbols, and codes contained in schedule.

      7) Mounting locations for door hardware.

      8) Door and frame sizes and materials.

9) Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

a) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.

10) List of related door devices specified in other Sections for each door and frame.

c. Submittal Sequence: Submit the final door hardware groups at earliest possible date, particularly where approval of the door hardware groups must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware groups.

2. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.4 Quality Assurance

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Design Professional, and Owner about door hardware and keying.

2. Installer shall have warehousing facilities in Project's vicinity.

3. Scheduling Responsibility: Preparation of door hardware and keying schedules.

4. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

1. Electrified Door Hardware Consultant Qualifications: A qualified Architectural Hardware Consultant who is experienced in providing consulting services for electrified door hardware installations.

C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1. Test Pressure: Test at atmospheric pressure After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1016 mm) or less above the sill.

E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Keying Conference: Conduct conference at Project site to comply with requirements of Division 01. In addition to Owner, Construction Manager, Contractor, and Design Professional conference participants shall also include Installer's Architectural Hardware Consultant and Owner's security consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.

2. Preliminary key system schematic diagram.

3. Requirements for key control system.

4. Address for delivery of keys.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 01. Review methods and procedures related to electrified door hardware including, but not limited to, the following:

1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.

2. Review sequence of operation for each type of electrified door hardware.

3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

4. Review required testing, inspecting, and certifying procedures.

1.5 Delivery, Storage, And Handling

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification related to the final door hardware groups, and include basic installation instructions, templates, and necessary fasteners with each item or package.

C. Manufacturer of permanent cores and keys to deliver permanent cores and keys to Hardware Installation Contractor, at his place of business, by registered mail or overnight package service.

1.6 Coordination

A. Coordinate layout and installation of recessed pivots with floor construction. Cast anchoring inserts into concrete.

B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, security system, and/or building control system.

D. Existing Openings: Where new hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide for proper operation.

1.7 Warranty

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including excessive deflection, cracking, or breakage.
   b. Faulty operation of operators and door hardware.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Two years from date of Substantial Completion, except as follows:

   a. Electromagnetic and Delayed-Egress Locks: Five years from date of Substantial Completion.
   b. Exit Devices: Three years from date of Substantial Completion.
   c. Manual Closers: Ten (10) years from date of Substantial Completion.

1.8 Maintenance Service

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

Part 2 Products

2.1 Keying

A. All cylinders shall be keyed to the existing Schlage Primus Level 3 Grand Master key system.

B. All cylinders shall be key removable (Inter-changeable) core type.

C. Provide temporary cores during the construction period.

D. Provide Schlage cylinders for Items 101 to 104.

2.2 Hardware Items

A. Hanging Devices (000)

1. Furnish the type as listed.

2. Catalog reference.

   a. McKinney. (Items 001 to 003.)

3. Item Description.

a.	001 – Mortise Hinge T4B3786 - NRP	Note 1	652
b.	002 – Mortise Hinge TB2714 - NRP	Note 2	652
c.	003 – Mortise Hinge TB2714	Note 2	652

4. Notes.

   a. Note A: All doors are equipped with four hinges.
   b. Note B: The hinge size is 4.5 x 4.5.
   c. Note 1: Replace the lower center hinge with T4B3786-CC6.
   d. Note 2: Replace the lower center hinge with TB2714-CC6.

B. Active Leaf Locking Devices (100)

1. Furnish the type as listed.

2. Catalog reference.

   a. Von Duprin. (Items 101 to 104.)
   b. Schlage . (Item 105.)

3. Item Description.

a.	101 – Exit Device E9847WDC-L-FSE-12-LBR	626
b.	102 – Exit Device E9827L-FSE-12-LBR	626
c.	103 – Exit Device E98L-FSE-12	626
d.	104 – Exit Device E9875L-FSE-12	626
e.	105 – Mortise Lock-set L9080DEU-12A	626

4. Notes.

   a. Note A: Provide trim as indicated.
   b. Note B: The above devices replace existing devices. Turn over all hardware to the Convention Center.

C. Inactive Leaf Locking Devices (200)

1. Not required.

D. Door Control Devices (300)

1. Furnish the type as listed.

2. Catalog reference.

a. Rockwood. (Item 301.)

3. Item Description.

a. 301 – Floor Stop 471 Note 1 626

4. Notes.

a. Note A: The degree of swing shall be 180 degrees or as controlled by the hardware or the partition layout.
b. Note 1: Re-use the existing stop.

E. Door Closing Devices (400)

1. Furnish the type as listed.

2. Catalog reference.

a. LCN. (Items 401, 402.)

3. Item Description.

a. 401 – Concealed Closer 2014-H Note 1 689
b. 402 – Surface Closer 4011 Note 1, 2 689

4. Notes.

a. Note 1: Re-use the existing door closer.
b. Note 2: Replace the arm with a hold open arm. Part No. 4010-3049.

F. Push Units (500)

1. Not required.

G. Pull Units (600)

1. Not required.

H. Door Protection Plates (700)

1. Furnish the type as listed.

2. Catalog reference.

a. Rockwood. (Item 701.)

3. Item Description.

a.	701 – Kick Plate K1050 – B3E – 8” x 34”	Note 1	630

4. Notes.

a. Note 1: Re-use the existing kick plate.

I. Miscellaneous Equipment (800)

1. Furnish the type as listed.

2. Catalog reference.

a.	Rockwood.	(Item 801.)
b.	Ives.	(Item 802.)

3. Item Description.

a.	801 – Door Silencer 608	Note 1	STD
b.	802 – Door Viewer 696	Note 2	626
c.	803 – Security Switch	Note 3	- - -

4. Notes.

a. Note 1: Provide silencers, 3 per single and two per pair.
b. Note 2: Re-use the existing viewer.
c. Note 3: This switch is provided by the security contractor, list in your hardware schedule for coordination purposes.

J. Thresholds and Door Seals (900)

1. Furnish the type as list.

2. Catalog reference.

a.	Pemko.	(Item 901.)
b.	NGP.	(Item 902.)

3. Item Description.

a.	901 – Head and Jamb Seal PF181	Note 1	BRN
b.	402 – Door Sweep 200N	Note 2	628

4. Notes.

a. Note 1: Re-use the existing seals.
b. Note 2: Re-use the existing sweeps.

2.3 Hardware Finishes

A. The finish for all hardware in designated in the item description by the 600 series number established by the Builders Hardware Manufacturer’s Association unless indicated otherwise.

B. The designation STD indicates that the manufacturer’s standard finish is designated.

2.4 Hardware Groups

A. Each group number represents a collection of hardware items necessary to complete the opening.

B. Provide sufficient quantities of each item listed along with proper fasteners.

C. A group number is assigned to each door in the door schedule.

D. The following chart contains the groups of item components and the typical locations.

Hardware Group	Hanging Device	Active Leaf Locking Devices	Inactive Leaf Locking Devices	Door Control Devices	Door Closing Devices	Push Units	Pull Units	Door Protection Plates	Miscellaneous Equipment	Thresholds and Door Seals
GRP	000	100	200	300	400	500	600	700	800	900
01	001 001	101 101		301 301	401 401				803 803	901
02	002 002	102 102		301 301	402 402			701 701	802 803 803	901 902 902
03	002	103		301	402			701	802 803	901
04	001	104		301	401				803	901
05	003	105		301	402				803	901

2.5 Substitutions

A. Substitutions shall not be permitted.

Part 3 Execution

3.1 Examination

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

A. Steel Doors and Frames: Comply with DHI A115 Series.

1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

B. Wood Doors: Comply with DHI A115-W Series.

3.3 Installation

A. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

3.4 Field Quality Control

A. Independent Architectural Hardware Consultant: Engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 Adjusting

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

2. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

3.6 Cleaning And Protection

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 Demonstration

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes.

END

Part 1 General

1.1 Related Documents

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

B. The Division 26 Contractor shall be responsible for all work listed on the construction documents and in the specifications for Divisions 26, 27 and 28.

1.2 Summary

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 Definitions

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 Submittals

A. Product Data: For sleeve seals.

1.5 Coordination

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping and conduit installed at required slope.

4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

D. Coordinate sleeve selection and application with selection and application of firestopping.

Part 2 Products

2.1 Sleeves For Raceways And Cables

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

   a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
   b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 Sleeve Seals

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

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

   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

3. Pressure Plates: Plastic. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 Grout

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

Part 3 Execution

3.1 Common Requirements For Electrical Installation

A. Comply with NECA 1.

B. B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 Sleeve Installation For Electrical Penetrations

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 Sleeve-Seal Installation

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 Firestopping

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly.

END

Part 1 General

1.1 Related Documents

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

1.2 Summary

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 Definitions

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 Submittals

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.5 Quality Assurance

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 Coordination

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

Part 2 Products

2.1 Conductors And Cables

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

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THW, THHN-THWN, XHHW, UF, USE and SO.

D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC mineral insulated, metal-sheathed cable, Type MI, Type SO and Type USE with ground wire.

2.2 Connectors And Splices

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

1. AFC Cable Systems, Inc.
2. O-Z/Gedney; EGS Electrical Group LLC.
3. 3M; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

Part 3 Execution

3.1 Conductor Material Applications

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 Conductor Insulation And Multiconductor Cable Applications And Wiring Methods

A. Exposed Feeders: Type THHN-THWN, metal-clad (MC) cable.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, metal-clad (MC) cable.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHNTHWN, single conductors in raceway.

D. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, metal-clad (MC) cable.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad (MC) cable.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.

3.3 Installation Of Conductors And Cables

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 Connections

A. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 Field Quality Control

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

   a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
   b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END

Part 1 General

1.1 Related Documents

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

1.2 Summary

A. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Common ground bonding with lightning protection system.

1.3 Submittals

A. Product Data: For each type of product indicated.

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:

1. Ground rods.
2. Ground rings.
3. Grounding arrangements and connections for separately derived systems.
4. Grounding for sensitive electronic equipment.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

1. Instructions for periodic testing and inspection of grounding features at test wells ground rings grounding connections for separately derived systems based on NETA MTS, NFPA 70B.
   a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
   b. Include recommended testing intervals.

1.4 Quality Assurance

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with UL 467 for grounding and bonding materials and equipment.

Part 2 Products

2.1 Conductors

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

   1. Solid Conductors: ASTM B 3.

   2. Stranded Conductors: ASTM B 8.

   3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.

   4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

   5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.

2.2 Connectors

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

   1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 Grounding Electrodes

A. Ground Rods: Copper-clad steel 3/4 inch by10 feet in diameter.

Part 3 Execution

3.1 Applications

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.

2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.

3. Connections to Ground Rods at Test Wells: Bolted connectors.

4. Connections to Structural Steel: Welded connectors.

3.2 Grounding Underground Distribution System Components

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk

insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.3 Equipment Grounding

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.

2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

G. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

H. All metal cable tray and ladder racks shall be grounded to the system ground bus in the room or closet of origin.

3.4 Installation

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor. See details shown in the construction documents for additional scope of work.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.

1. Install tinned-copper conductor not less than No. 2/0AWG for ground ring and for taps to building steel.

2. Bury ground ring not less than 24 inches from building foundation. Unless indicated otherwise on the drawing.

I. Under Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.

2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.5 Field Quality Control

A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

   a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.

3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Report measured ground resistances that exceed the following values:

1. Power Equipment or System with Capacity 500 kVA and Less: 10 ohms.

2. Power Equipment or System with Capacity 500 to 1000 kVA: 5ohms.

3. Power Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1ohm(s).

5. Cable Tray and Ladder Racks: 10 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Design Professional promptly and include recommendations to reduce ground resistance.

END

Part 1 General

1.1 Related Documents

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

1.2 Summary

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. Division 26 Section "Common Work Results for Electrical".

1.3 Definitions

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 Performance Requirements

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 Submittals

A. Product Data: For the following:

1. Steel slotted support systems.

2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.

2. Steel slotted channel systems. Include Product Data for components.

3. Nonmetallic slotted channel systems. Include Product Data for components.

4. Equipment supports.

C. Welding certificates.

1.6 Quality Assurance

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 Coordination

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

Part 2 Products

2.1 Support, Anchorage, And Attachment Components

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

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

   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. Unistrut; Tyco International, Ltd.

2. Painted Coatings: Manufacturer’s standard painted coating applied according to MFMA-2.2.

2.2 Channel Dimensions (Selected for Applicable Load Criteria)

A. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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

      1) Hilti Inc.

      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

      3) MKT Fastening, LLC.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

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

      1) Cooper B-Line, Inc.; a division of Cooper Industries.

      2) Hilti Inc.

      3) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.3 Fabricated Metal Equipment Support Assemblies

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

Part 3 Execution

3.1 Application

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

   1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 Support Installation

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

   1. To New Concrete: Bolt to concrete inserts.

   2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

   3. To Existing Concrete: Expansion anchor fasteners.

   4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.

   5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.

6. To Light Steel: Sheet metal screws.

7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 Installation Of Fabricated Metal Supports

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 Concrete Bases

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete.

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 Painting

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END

Part 1 General

1.1 Related Documents

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

1.2 Summary

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 Definitions

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.4 Submittals

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.

2. For handholes and boxes for underground wiring, including the following:

   a. Duct entry provisions, including locations and duct sizes.
   b. Frame and cover design.

c. Grounding details.
d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
e. Joint details.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

D. Qualification Data: For professional engineer and testing agency.

E. Source quality-control test reports.

1.5 Quality Assurance

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

Part 2 Products

2.1 Metal Conduit And Tubing

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

1. AFC Cable Systems, Inc.

2. Allied Tube & Conduit; a Tyco International Ltd. Co.

3. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. EMT: ANSI C80.3.

E. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.

2. Fittings for EMT: Steel or die-cast, set-screw or compression type.

3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

F. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 Nonmetallic Conduit And Tubing

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

1. AFC Cable Systems, Inc.
2. Lamson & Sessions; Carlon Electrical Products.
3. RACO; a Hubbell Company.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Type EPC-40-PVC**,** unless otherwise indicated.

D. LFNC: UL 1660.

E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.3 Metal Wireways

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

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, holddown straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type.

E. Finish: Manufacturer's standard enamel finish.

2.4 Surface Raceways

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Design Professional.

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

a. Wiremold Company (The); Electrical Sales Division.Walker Systems, Inc.
b. Hubbell Incorporated; Wiring Device-Kellems Division.
c. Thomas & Betts Corporation.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Design Professional from manufacturer's standard colors.

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

a. Wiremold Company (The); Electrical Sales Division.
b. Hubbell Incorporated; Wiring Device-Kellems Division.
c. Lamson & Sessions; Carlon Electrical Products.

2.5 Boxes, Enclosures, And Cabinets

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

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.

2. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.

3. RACO; a Hubbell Company.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover. Use aluminum type for non-ferrous applications.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.

F. Nonmetallic Floor Boxes: Nonadjustable, round.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

J. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

Part 3 Execution

3.1 Raceway Application

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC- 40 -PVC, direct buried or concrete encased.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.
   d. Exhibit Halls.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

3.2 Installation

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Change from RNC, Type EPC-40-PVC to rigid steel conduit before rising above the floor.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where otherwise required by NFPA 70.

M. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C temperature change.
   c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   d. Attics: 135 deg F (75 deg C) temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.

3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

N. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures**,** equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

P. Set metal floor boxes level and flush with finished floor surface.

3.3 Protection

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END

Part 1 General

1.1 Related Documents

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

1.2 Summary

A. This Section includes steel wire mesh cable trays and aluminum ladder cable trays and all associated accessories.

1.3 Submittals

A. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.

1. Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

C. Coordination Drawings: Floor plans and sections, drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements. Show the following:

1. Vertical and horizontal offsets and transitions.

2. Clearances for access above and to side of cable trays.

3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

D. Field quality-control reports.

E. Operation and Maintenance Data: For cable trays to include in emergency, operation, and maintenance manuals.

1.4 Quality Assurance

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.5 Delivery, Storage, And Handling

A. Store indoors to prevent water or other foreign materials from staining or adhering to cable tray. Unpack and dry wet materials before storage.

B. Cable tray shall be stored in a well-ventilated, dry location. Unpack and dry wet materials before storage.

Part 2 Products

2.1 Manufacturers

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

1. Wiremold/Legrand.
2. Cooper B-Line, Inc.
3. Cope, T. J., Inc.; a subsidiary of Allied Tube & Conduit.

2.2 Materials And Finishes

A. Wire Basket Mesh Cable Trays, Fittings, and Accessories: Steel, complying with NEMA VE 1.

1. Zinc plated before fabrication.
2. Ten (10) foot field cuttable lengths.
3. Cable tray dimensions shall be 24 inches wide by 6 inches deep and total lengths required shall be derived from ELV drawing series.

B. Ladder Cable Trays, Fittings, and Accessories: Aluminum, complying with NEMA VE 1, Aluminum Association's Alloy 6063-T6 for rails, rungs, and cable trays, and Alloy 5052-H32 or Alloy 6061-T6 for fabricated parts; with chromium-zinc, ASTM F 1136, splice-plate fasteners, bolts, and screws.

C. Sizes and Configurations: Refer to the Telecom IDF room layouts on Telecom Drawings for specific requirements for types, materials, sizes, and configurations. Otherwise, typical ladder cable tray dimensions shall be 24 inches wide by 6 inches deep with rungs 6 inches on centers.

2.3 Cable Tray Accessories

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Barrier Strips: Same materials and finishes as cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.4 Warning Signs

A. Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

B. Materials and fastening are specified in Division 26 Section "Identification for Electrical Systems."

2.5 Source Quality Control

A. Perform design and production tests according to NEMA VE 1.

Part 3 Execution

3.1 Cable Tray Application

A. Wire basket mesh cable tray shall be used throughout the building with the exception of the interior of all MDF, IDF and Tele/Comm closets.

B. Ladder cable tray shall be used inside MDF, IDF and Tele/Comm closets as indicated on drawings.

3.2 Cable Tray Installation

A. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.

B. Remove burrs and sharp edges from cable trays.

C. Fasten cable tray supports to building structure.

1. Place supports so that spans do not exceed maximum spans on schedules.
2. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
3. Support bus assembly to prevent twisting from eccentric loading.
4. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
5. Locate and install supports according to NEMA VE 1.

D. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.

E. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA VE 1. Space connectors and set gaps according to applicable standard.

F. Make changes in direction and elevation using standard fittings.

G. Make cable tray connections using standard fittings.

H. Workspace: Install cable trays with enough space to permit access for installing cables.

I. Install barriers to separate cables of different systems, such as power, communications, and data processing.

J. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

3.3 Cable Installation

A. Install cables only when cable tray installation has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. On vertical runs, fasten cables to tray every 18 inches (457 mm). Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

D. In existing construction, remove inactive or dead cables from cable tray.

3.4 Connections

A. Ground cable trays according to manufacturer's written instructions.

B. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70.

3.5 Field Quality Control

A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:

1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.

2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.

3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.

4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.

5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.

6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.

7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.

B. Report results in writing.

3.6 Protection

A. Protect installed cable trays.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.

2. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

END

Part 1 General

1.1 Related Documents

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

1.2 Summary

A. This Section includes the following:

1. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.3 Submittals

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 Quality Assurance

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.5 Coordination

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

Part 2 Products

2.1 Raceway And Metal-Clad Cable Identification Materials

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:

1. Power Circuits: Black letters on an orange field.

2. Legend: Indicate system or service and voltage, if applicable.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.2 Conductor And Communication- And Control-Cable Identification Materials

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- (0.35-mm-) thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.

D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking nylon tie fastener.

E. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 Warning Labels And Signs

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, celluloseacetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning (120/208V systems): "WARNING – OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

3. Workspace Clearance Warning (480/277 systems): "WARNING – OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 48 INCHES (915 MM)."

4. Workspace Clearance Warning (13.2 KV systems): "WARNING – OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 72 INCHES (915 MM)."

2.4 Instruction Signs

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.

2. Punched or drilled for mechanical fasteners.

3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.5 Equipment Identification Labels

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and ultraviolet-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be **1 inch (25 mm)**.

2.6 Miscellaneous Identification Products

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength: 50 lb (22.6 kg), minimum.

3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

4. Color: Black, except where used for color-coding.

B. Paint:

1. Exterior Concrete, Stucco, and Masonry (Other Than Concrete Unit Masonry):

a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Exterior concrete and masonry primer.

2) Finish Coats: Exterior semigloss acrylic enamel.

2. Exterior Concrete Unit Masonry:

a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.

1) Block Filler: Concrete unit masonry block filler.

2) Finish Coats: Exterior semigloss acrylic enamel.

3. Exterior Ferrous Metal:

a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Exterior ferrous-metal primer.

2) Finish Coats: Exterior semigloss alkyd enamel.

4. Exterior Zinc-Coated Metal (except Raceways):

a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Exterior zinc-coated metal primer.

2) Finish Coats: Exterior semigloss alkyd enamel.

5. Interior Concrete and Masonry (Other Than Concrete Unit Masonry):

a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Interior concrete and masonry primer.

2) Finish Coats: Interior semigloss alkyd enamel.

6. Interior Concrete Unit Masonry:

a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.

1) Block Filler: Concrete unit masonry block filler.

2) Finish Coats: Interior semigloss acrylic enamel.

7. Interior Gypsum Board:

a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Interior gypsum board primer.

2) Finish Coats: Interior semigloss acrylic enamel.

8. Interior Ferrous Metal:

a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Interior ferrous-metal primer.

2) Finish Coats: Interior semigloss acrylic enamel.

9. Interior Zinc-Coated Metal (except Raceways):

a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.

1) Primer: Interior zinc-coated metal primer.

2) Finish Coats: Interior semigloss acrylic enamel.

C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

Part 3 Execution

3.1 Application

A. Raceways and Duct Banks More Than 600 V Concealed within Buildings: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high black letters on 20-inch (500-mm) centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways and Metal-Clad Cables More Than 600 V: Identify with "DANGERHIGH VOLTAGE" in black letters at least 2 inches (50 mm) high, with snap-around labels. Repeat legend at 10-foot (3-m) maximum intervals.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with orange snap-around label.

D. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:

1. Fire Alarm System: Red.
2. Fire-Suppression Supervisory and Control System: Red and yellow.
3. Combined Fire Alarm and Security System: Red and blue.
4. Security System: Blue and yellow.
5. Mechanical and Electrical Supervisory System: Green and blue.
6. Telecommunication System: Green and yellow.
7. Control Wiring: Green and red.

E. Power-Circuit Conductor Identification: For primary and secondary conductors No. 2 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

F. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use write-on tags. Identify each ungrounded conductor according to source and circuit number.

G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.
b. Controls with external control power connections.

2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

K. Instruction Signs:

1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

   a. Indoor Equipment: laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:

   a. Panelboards, electrical cabinets, and enclosures.
   b. Access doors and panels for concealed electrical items.
   c. Electrical switchgear and switchboards.
   d. Transformers.
   e. Emergency system boxes and enclosures.
   f. Disconnect switches.
   g. Enclosed circuit breakers.
   h. Contactors.
   i. Battery inverter units.
   j. Battery racks.
   k. Data cable terminal equipment.
   l. Audio components, racks, and controls.
   m. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
   n. Monitoring and control equipment.
   o. Uninterruptible power supply equipment.
   p. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

3.2 Installation

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.

2. Colors for 208/120-V Circuits:

   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.

3. Colors for 480/277-V Circuits:

   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

END

Section 263353 Uninterruptible Power Supply (UPS) Systems (Stand Alone)

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Two (2) UL listed uninterruptible power supply (UPS) systems to supply regulated alternating current (ac) power for voice evacuation sound amplifiers. UPS systems shall be complete and fully operational, and designed for unattended operation. The UPS units shall utilize rack mounted N+ 1 redundant, scalable array architecture, using replaceable 10kVA power modules. The power modules shall operate in parallel, and be configured for N+1 redundant operation at rated load.

B. The UPS systems shall be installed on concrete housekeeping pads.

C. One unit will be designated the “Master Control Room UPS”. The second unit will be designated the “Ballroom UPS”.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Common Work Results for Electrical: Division 26.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. A clear statement of proposed deviations from the Specifications.

C. Shop Drawings, including the following:

1. Overall dimensions and weights of the UPS system and battery and all auxiliary equipment.
2. Single-line diagram of the proposed systems.
3. Data required to completely design the foundations for equipment package.
4. Front views, internal layout and wiring diagrams.

D. Product Data:

1. Manufacturer's model numbers.
2. Fact sheet giving ratings, heat load, exhaust, ventilation, MTBF and MTTR, and other pertinent performance data.

3. A description of diagnostic system, procedures and monitoring capabilities.

4. Itemized bill of materials.

E. Quality Control Procedures: Factory and Field Test Procedures.

F. Certifications:

1. Factory-certified data of system and component ratings and performance characteristics.

2. Certified Factory Test Reports.

3. Certified Field Test Reports.

G. Closeout Submittals:

1. Operation and Maintenance Manuals.

2. Warranty.

3. Service Contract, including size and capability of local service organization, including experience level of service personnel, response time to service calls, and escalation procedure.

1.4 Quality Assurance

A. Manufacturer: Complete system shall be engineered, fabricated, tested and warranted by one (1) source.

B. Vendor Qualifications: Vendor shall be a manufacturer regularly engaged in production of UPS systems. Vendor shall have complete local parts and service availability with factory-employed technicians available 24 hours a day, seven (7) days a week.

C. Approved UPS System Manufacturer: Products of following UPS system manufacturer is acceptable:

1. Basis of Design: APC # SY30K40F, complete with Premium XR battery enclosure, additional 30KW battery frame with battery modules, and 30KW PDU (30 pole 208/120 volt 3 phase 4 wire distribution panel), with maintenance bypass.

2. Approved equals are acceptable.

D. Referenced Codes and Standards:

1. American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

C62.41	Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

2. Information Technology Industry Council (ITI)/ Formerly known as the Computer and Business Equipment Manufacturers Association (CBEMA)

3. ETL Testing Laboratories, Inc. (ETL)

4. Institute of Electrical and Electronics Engineers (IEEE)

450	Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications
484	Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications
1184	Guide for the Selection and Sizing of Batteries for Uninterruptible Power Systems
1188	Recommended Practice for Maintenance, Testing, and Replacement of Valve Regulated Lead-Acid Batteries for Stationary Applications
1189	Guide for Selection of Valve-Regulated Lead Acid (VRLA) Batteries for Stationary Applications

5. International Electrotechnical Commission (IEC)

6. National Electrical Manufacturers Association (NEMA)

7. National Fire Protection Association (NFPA)

70	National Electrical Code

8. International Code Council (ICC)

IBC	International Building Code

9. Underwriters Laboratories, Inc. (UL)

94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
1778	Uninterruptible Power Supply Equipment
	Labeling and Listing Requirements

Part 2 Products

2.1 System Description

A. UPS system shall consist of a rectifier/battery charger, input circuit breaker, matching battery cabinets, removable power modules (parallel connected), static bypass switch, external maintenance bypass switch cabinet (MBC), protective devices and accessories as specified herein which shall automatically assure continuity of electric power within specified tolerances, without interruption, upon failure or deterioration of the input AC power source. Continuity of electric power to load shall be maintained while inverter is being supplied power from the batteries, up to protection time specified or until restoration of input AC power, whichever occurs first.

2.2 Modes Of Operation

A. UPS system shall be designed to operate as an on-line reverse transfer system in the following modes:

1. Normal: Inverters shall continuously supply power to critical load. Rectifier/battery charger shall derive power from utility AC source and supply DC power to inverters while simultaneously float-charging battery.

2. Emergency: Upon failure of utility AC power source, critical load shall be supplied by inverters which, without any switching, shall obtain its power from battery. There shall be no interruption or disturbances to critical load upon failure or restoration of utility AC power source.

3. Recharge: Upon restoration of utility AC power source (prior to complete battery discharge), rectifier/battery charger shall power inverters and simultaneously recharge battery. This shall be an automatic function and shall cause no interruption to critical load.

4. Bypass Mode: If load must be transferred to bypass source, static bypass transfer switch shall be used to transfer load from inverter output to bypass source without interruption.

5. Maintenance Bypass/Test Mode: If UPS must be taken out of service for maintenance or repair, static bypass transfer switch shall be used to transfer load to alternate source without interruption. An external maintenance bypass cabinet (MBC) shall be provided to isolate UPS inverter output and static bypass transfer switch for maintenance. This shall allow UPS to be tested or repaired without affecting load operation.

6. Downgrade: If battery only is to be taken out of service for maintenance, it shall be disconnected from rectifier/battery and inverter by means of an external battery disconnect. UPS shall continue to function as indicated, except for power outage protection and dynamic characteristics.

2.3 System Capacity

A. Output capacity shall be 30kW /30kVA, scalable to 40kW.

B. Battery Capacity:

1. Discharge Time to End Voltage: 15 minutes, at 77 degrees F, under full load.

C. AC Input:

1. Voltage: 208 / 120 volts.

2. Number of Phases: 3-phase, 4-wire, and ground.

3. Voltage Range: Plus 10 percent, minus 15 percent, without affecting battery-float voltage or output voltage.

4. Frequency: 60 Hz, plus or minus 5 percent.

5. Input Current Distortion: less than 6 percent THD at full load.

6. Short Circuit withstand rating: 30,000 symmetrical amperes.

D. UPS AC Output:

1. Voltage: 208 volts line-to-line; 120 volts, line-to-neutral.

2. Number of Phases: 3-phase, 4-wire, and ground.

3. Voltage Regulation:

   a. Balanced Load: Plus or minus 1.0 percent.
   b. 50 Percent Load Imbalance, Phase-To-Phase: Plus or minus 2 percent.
   c. No-Load Voltage Modulation: Plus or minus 1 percent.

4. Voltage Adjustment: Plus or minus 5 percent manually programmable.

5. Frequency: 60 Hz.

6. Frequency Regulation: Plus or minus 0.1 percent.

7. Frequency Drift: Plus or minus 0.1 percent over any 24-hour interval at stated ambient conditions.

8. Harmonic Content (RMS voltage): 3 percent single harmonic, maximum; 5 percent total, maximum.

9. Load Power Factor Range: 1.0 to 0.8 lagging.

10. Phase Displacement:

    a. Balanced Load: Plus or minus 1 degree of bypass input.
    b. 50 Percent Load Imbalance, Phase-To-Phase: Plus or minus 3 degrees of bypass input.

11. Wave-Form Deviation Factor: 5 percent at no load.

12. Overload (At Full Voltage): 150 percent load for 30 seconds; 105% continuous.

13. Current Limit: 150 percent full-load current.

E. Transient Response:

1. Voltage Transients:

   a. 20 percent Load Step: Plus or minus 2 percent.
   b. 30 percent Load Step: Plus or minus 3 percent.
   c. 50 percent Load Step: Plus or minus 3 percent.
   d. Transient recovery: within 60 milliseconds.

2. Frequency:

   a. Transients: Plus or minus 0.5 Hz maximum.
   b. Slew Rate: 1.0 Hz maximum per second.

F. Efficiency:

1. System Efficiency: Minimum 90 percent at full load.

G. Available Short Circuit Current:

1. Provide UPS system tested and suitable for safe and reliable operation from a 208 volt, three phase power source with 30,000 A symmetrical interrupting capacity. Provide suitably rated input circuit breaker, static switch, bus bracing, and withstand duty.

H. Environmental Conditions:

1. Temperature: UPS system shall be capable of withstanding any combination of the following external environmental conditions without mechanical or electrical damage or degradation of operating characteristics:

   a. Operating Temperature Range: 32 to 104 degrees F.
   b. Non-Operating and Storage Ambient Temperature: Minus 4 to plus 158 degrees F.
   c. Battery: 77 plus or minus 3 degrees F.

2. Relative Humidity: 0 to 95 percent RH without condensation.

3. Maximum Noise Level Emanating from Fully Operational and Loaded Unit: 64 dBA at 3.3 feet in front of cabinet.

2.4 UPS Modules

A. General Description:

1. UPS modules shall consist of parallel connected, removable power modules, protective devices and accessories as required for operation.

B. Rectifier/Charger Units:

1. Rectifier/charger unit shall use transistors (IGBT) and shall provide direct current to dc bus.

2. Rectifier/charger unit shall be provided with an input circuit breaker or fuses. Circuit breaker shall be sized to simultaneously handle full-rated load and battery recharge current.

3. When operating on battery, a low battery protection circuit shall be used to monitor the DC bus voltage. The UPS inverter shall be automatically turned off when the battery voltage reaches a minimum of 1.63 volts per cell.

C. Inverter Unit:

1. Inverter output shall be derived from a transistor (IGBT) type inverter design which uses microprocessor control technology to maintain regulation of the output voltage waveform and have the operating characteristics as specified. The inverter shall be capable of providing the specified precise output power characteristics while operating over the battery bus range. The power section of the inverter shall be constructed of plug-in modules to facilitate maintenance.

2. Inverter shall be capable of supplying currents and regulated voltage for overloads up to 150 percent current for 30 seconds. The static bypass transfer switch shall transfer the load to bypass if the overload exceeds either the inverter's instantaneous rating or the time periods previously stated.

3. Inverter shall be protected from excessive overloads, including faults and reverse currents, by electronic means in order to prevent damage to power semiconductors from cascade-type failures.

4. Inverter shall have built-in protection against undervoltage, overcurrent, and overvoltage surges on the output.

5. Inverter shall be provided with thermal overload protection to alarm and protect against fan failures and high internal ambient conditions. The alarm shall sound upon loss of one (1) fan in multiple-fan installations.

D. Static Bypass Transfer Switch:

1. A static bypass transfer switch shall be provided as an integral part of the UPS. The control logic shall contain an automatic transfer circuit that senses the status of the inverter logic signals and alarm conditions, and provide an uninterrupted transfer of the load to the bypass input without exceeding the transient limits specified herein when a malfunction occurs in the UPS or when an external overload condition occurs. The static bypass transfer switch shall be an electronic type static switch rated for 100 percent continuous duty which provides a make-before-break or overlap-type transfer.

2. Static bypass transfer switch shall be used to connect the bypass input or the UPS inverter output to the critical load when required, and shall have the following features:

a. Uninterrupted Transfer: The static bypass transfer switch shall automatically cause the bypass input to assume the critical load without interruption after the logic senses one of the following conditions and the UPS inverter output is synchronized to the bypass input:

1) Inverter overload exceeds unit's rating.

2) Battery protection period expired and bypass available.

3) Inverter failure.

b. Manual Transfer: A manually-initiated static transfer shall be made from the system status and control panel by turning the UPS inverter off.

c. Overload Ratings: The static bypass transfer switch shall have the following overload characteristics:

1) 1000 percent of UPS output rating for 30 cycles.

2) 125 percent of UPS output rating for 5 minutes.

d. Forced Transfer: The control logic circuitry shall provide the means of making a forced or reverse transfer of the static bypass transfer switch on an interrupted basis. Minimum interruption shall be 200 milliseconds when the UPS inverter is not synchronized to the bypass AC input source.

E. External Maintenance Bypass Switch cabinet (MBC):

1. Provide an external maintenance bypass for complete electrical isolation of the UPS module and static bypass for servicing without interruption to the connected load. Maintenance bypass operation shall allow transfer from UPS to bypass and back to normal operation without interruption to the connected load. The MBC shall be constructed in a standard free-standing equipment rack.

F. System Status and Control:

1. Provide a system status and control panel which controls, monitors and displays the system's operations and parameters. The system status and control panel shall be provided with a touch control key pad for entering data and a visual display to be used for operator interface, parameters monitored, system diagnostics and alarm status. The display shall be available in English, and provide instructions complete enough for operation by untrained personnel.

2. Monitor and display the following metered parameters when addressed to do so:

   a. Input voltage (L-L).
   b. Input current/phase.
   c. Input frequency.
   d. UPS output voltage (L-L).
   e. UPS output voltage (L-N).
   f. UPS output current/phase.
   g. UPS output frequency.
   h. UPS output percent load of the most heavily loaded phase.
   i. DC voltage.
   j. Battery current (charge/discharge).
   k. Time on battery.
   l. Time remaining on battery.

3. Audible alarm reset touch pad shall be used to silence the audible alarm. A new alarm sensed after the original alarm has been silenced shall activate the audible alarm.

4. Visual display shall provide all necessary operator instructions for bringing the UPS on line and for shutting the equipment off under normal or emergency conditions. A step-by-step procedure shall be provided for each sequence of operation. The following menus shall be displayed:

   a. INSTRUCTIONS: This menu shall explain the function of every touch pad key on the system status and control panel.
   b. COMMANDS: This menu shall be used to force start or force stop the charger and the inverter.
   c. START-UP: This menu shall be used to start up the UPS.
   d. BYPASS PROCEDURE: This menu shall provide step-by-step procedure of transferring the load to and from maintenance bypass.
   e. DIAGNOSTICS: This menu shall be used to locate the faulty assembly in the UPS.
   f. COMMUNICATIONS: This menu shall be used for optional external communications with the UPS.

5. System Status and Alarms: The following system status and alarm conditions shall be displayed on the UPS visual display:

   a. Intelligence module inserted.
   b. Intelligence module removed.
   c. Redundant Intelligence module inserted.
   d. Redundant intelligence module removed.
   e. Number of Power modules increased.
   f. Number of Power modules decreased.
   g. Number of external battery cabinets increased.
   h. Number of external battery cabinets decreased.
   i. Low battery warning.
   j. Battery undervoltage shutdown.
   k. Battery disconnect open.
   l. Input overvoltage or undervoltage.
   m. Input circuit breaker tripped.
   n. Redundancy has been lost.
   o. Inverter OFF.
   p. Inverter fuse blown.
   q. Fan failure.
   r. UPS overload shutdown.
   s. Inverter output contactor open.
   t. Inverter current limit.
   u. Static switch failure.
   v. Power supply fault.
   w. UPS overload.
   x. Load transferred to bypass due to overload.
   y. Load transferred to bypass due to internal protection.

6. Provide a real time clock (time and date), alarm history with time and date stamp, and memory back-up for the display.

7. A horn shall be activated upon detection of any UPS fault condition.

8. Form "C" dry contact closures for "UPS on battery" and "major faults" shall be provided. Contacts shall be rated for one ampere at 120 V ac or 24 V dc.

9. Equipment shall contain self-test and diagnostic circuitry such that a fault can be isolated down to a printed circuit assembly or plug-in power assembly level. Every printed circuit assembly and plug-in power assembly shall be monitored. Plug-in power assemblies that contain printed circuit assemblies shall be diagnosed as to either of the power semiconductors as being faulty. The failure code of any of the assemblies shall be displayed on the visual LCD display as being the assembly that needs to be replaced.

2.5 Storage Battery

A. Battery Description:

1. A storage battery of the valve-regulated, absorbed glass mat (AGM) or gel electrolyte technology, gas recombinant (greater than 99 percent), lead-calcium type, with sufficient ampere-hour rating to maintain UPS output at full capacity for the specified duration at 77 degrees F ambient temperature, shall be provided for each UPS. The battery shall be of high rate, heavy-duty, industrial design specifically designed for UPS service.

2. Provide a battery assembly in a matching cabinet to the UPS that requires front access only. Provide factory wired and torqued battery connections inside the cabinet. The battery assembly shall include a DC rated disconnect or circuit breaker that shall provide a positive means of isolating the battery from the rest of the system for maintenance. The battery disconnect shall be equipped with an undervoltage release and an auxiliary switch. The undervoltage release shall be used to open the battery disconnect upon activation of the emergency power off control located on the UPS control panel. The battery assembly shall be designed to allow for checking the torque on all battery connections in the battery system as well as providing sufficient access for maintenance. Individual battery cabinets shall be capable of being isolated from the DC link without requiring a complete shutdown of the string. Provide monitoring and alarm of open battery breakers via the auxiliary switch at the UPS display. External wiring interface shall be through the bottom or top of the assembly.

3. Cabinet Alarms: A smoke and high temperature alarm shall annunciate detection of either smoke or high temperature within the battery cabinet.

4. Battery shall be sized at 125 percent of required capacity to provide rated discharge time to end voltage at full load at the end of the warranty.

5. Float-type warranty shall be minimum of one (1) year covering parts and labor for battery repair and replacement and five (5) years pro-rata. Provide 5 year VRLA batteries with a minimum warranted cycle life of 1,200 - 60 second discharges or 200 - 15 minute discharges at the 15 minute discharge rate to 1.67 volts per cell. Any discharge cycle limitations shall be clearly stated in the proposal.

6. Battery container, cover and system components shall be flame-retardant conforming to UL 94VO and shall have a Limiting Oxygen Index (LOI) of 28 minimum.

2.6 Output PDU's

A. Provide each unit with a 30 pole, 208/120 volt 3 phase, 4 wire distribution panel connected to the UPS output for branch circuit wiring for the sound amplifiers.

B. Populate the distribution panelboard with 20 Amp, single pole, 120 volt circuit breakers.

2.7 Temperature Control/Ventilation

A. Provide adequate forced ventilation to ensure that all components are operated within their ratings. Fans shall have full redundancy. Air filters shall be furnished.

2.8 Factory Testing

A. UPS modules shall be factory load tested with 3-phase AC input power and with dc power for a minimum of four (4) hours, with all meter readings taken every 30 minutes. Load shall be balanced at rated kVA.

Part 3 Execution

3.1 Shipment

A. Equipment shall be cleaned prior to shipment. Openings shall be covered to prevent entrance of foreign material. Where required, desiccant bags shall be located within cabinets to provide a minimum of three (3) months protection. Machined surfaces shall be coated with a rust preventive material and covered or taped with moisture-proof tape.

B. Equipment shall be shipped with an internally-mounted impact recorder to ensure against mishandling during shipping and installation.

3.2 Installation

A. UPS system shall be set in place, wired and connected in accordance with approved Shop Drawings and manufacturer's written instructions.

3.3 Identification

A. Provide permanent identification of cable color codes.

3.4 Field Supervision, Startup And Testing

A. After installation of equipment, equipment manufacturer shall furnish the services of a competent engineer to check the wiring, start up the system, and field test all functions, interlocks and protective devices to ensure that the total system is functioning according to the intent of the design.

B. Field tests shall be performed under the supervision of a factory-trained representative of equipment manufacturer and witnessed by Owner's Representative. Results of the field tests shall be on the manufacturer's test report forms. The certified field test report shall be submitted upon completion of the test.

C. Field tests shall include:

1. Ensure that all shipping members have been removed.
2. Check for damage (for example, dents, scratches, frame misalignment and damage to panel devices).

3. Ensure that interiors are free of foreign materials, tools and dirt.

4. Attach a phase rotation meter to the UPS input, output and bypass buses, and observe proper phase sequences.

5. Torque test bus connections at shipping splits.

6. Check each electrical bus for proper phasing and identification.

7. Check and test selector switches and meters for proper operation.

8. Check doors for proper alignment and operation.

9. Check and test each breaker for proper mechanical and electrical operation.

10. Check input circuit breaker overcurrent trip device settings. Check and test indicating lights for proper operation and color.

11. Perform manufacturer's on site field test procedures.

12. Demonstrate to Owner's Representative that all functions and interlocks, as outlined in the Specification, have been implemented.

13. Installed system shall be load tested for a continuous 8-hour period by means of resistive load banks. System shall be continuously tested at 1/2 load for two hours, 3/4 load for two hours and full load for four (4) hours. Equipment manufacturer shall provide resistive load banks of total kW load of equipment to facilitate startup under loaded conditions, and to conduct load tests described above. Instrument readings shall be recorded every 1/2 hour.

14. Battery System Field Tests:

    a. Perform visual inspection of battery installation per IEEE Standard 450, Annex E.
    b. Perform mechanical inspection of battery system including all inter-cell, inter-tier, inter-rack, inter-cabinet, inter-aisle and UPS/Disconnect connections for excessive stress on battery terminals.
    c. Prior to load testing, equalize the battery system per manufacturer’s recommendation. Establish initial battery conditions in accordance with IEEE Standard 1188.

3.5 Training

A. Operation of the system shall be thoroughly demonstrated to satisfaction of Owner’s Representative. At least one (1) session, minimum four (4) hours, shall be held at Owner's site.

3.6 Operation And Maintenance Manuals

A. Furnish manuals to Owner’s Representative and record copy to Design Professional. Manuals shall possess sufficient detail and clarity to enable Owner's technicians to understand, operate and maintain the equipment, and to identify replaceable parts. Provide address and telephone number of service organization in manuals.

B. Manuals shall be divided into the following distinct sections:

1. General description.
2. Operating instructions.
3. Routine maintenance (parts, schedules, tests).
4. Troubleshooting (step-by-step chart format).
5. Data (bill of materials, single-line and three-line diagrams, schematic diagrams, layouts, exploded views, parts lists and performance characteristics).
6. Recommended spare parts stocking list.

C. Manufacturer's standard catalog is not acceptable.

3.7 Warranty And Service

A. Warranty:

1. Equipment manufacturer shall guarantee all equipment to be free of defects in workmanship and material for a period of one (1) year from Date of Field Testing and Final Acceptance by Owner.
2. All defects in material and workmanship and/or failure to meet guaranteed performance shall be corrected by manufacturer, at his own expense, within thirty (30) days after he has been notified in writing of his failure to meet the Guarantee. Owner reserves the right to use the equipment in the meantime until service or replacement is performed.
3. Submit Certificate of Warranty.

B. Service: Equipment manufacturer shall make available to Owner, at completion of Guarantee Period, a maintenance and service agreement via the nearest certified vendor's service center.

END

Part 1 General

1.1 Related Work Specified Elsewhere (Non-inclusive)

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

1.2 Definitions

A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and elevated side rails.

B. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails that are elevated from connecting transverse members (rungs).

C. Cable Runway/Ladder Rack: A fabricated structure consisting of two longitudinal side rails that are level with connecting transverse members (rungs).

D. WAO (Work Area Outlet)/Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Closeout Submittals:

1. Warranty: Draft of Warranty prior to start of fabrication or construction. Final Warranty after Date of Substantial Completion. Include proof of warranty data submission to manufacturer for elements of work warranted by manufacturers.

2. Project Record Documents:

   a. Include cable routing, frame and cable labeling, cable termination points, equipment room layouts and distribution frame installation details. Provide complete list showing each floor, room number, location, cable length, cable ID number and labeling, rack, panel, block connections, telecom room number, and outlet location description.
   b. Include electronic copy of testing data with record documents.
   c. Submit plan drawings showing installation route of fiber backbone and rack elevations of termination hardware. Submit plan drawings in hard copy, pdf and as AutoCAD files. Confirm required AutoCAD version with Construction Manager.

1.4 Quality Assurance

A. Certifications:

1. Field Representative Information: Name, address and telephone number of Installer's field representative.

2. Certify in writing conformance with indicated Installer Qualifications. Include names, addresses and phone numbers of references, who may be contacted to verify quality of Installer's previous projects and performance.

3. Include Manufacturer's Certification from each product manufacturer.

B. Installer Organizational Qualifications

1. Installer shall be a certified installation organization for indicated cables and connectors, and recognized as such by product manufacturers at the time of the bid.

2. Installer shall own and maintain tools and equipment for installation and testing of optical cabling systems and employ personnel trained in the use of such tools and equipment.

3. Installation of cables, connectors and testing shall be accomplished by technicians who have been regularly installing telecommunications cabling systems of comparable size, scope and complexity:

   a. Lead Technicians shall be BICSI Certified Technician
   b. All installers shall be either BICSI Certified Installers or have completed a state approved Apprentice program for communications installation.
   c. An Apprentice in a state approved Apprentice program for communications installation may work at the site under supervision of a mentor, for support of the cable installation.

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

D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

E. Grounding: Comply with ANSI-J-STD-607-A.

F. Reference Codes and Standards:

1. The Contractor shall meet or exceed requirements of all national, state, county, municipal and other authorities having jurisdiction over communication and electrical construction on this Project.

2. Work and materials shall comply with the following applicable codes and standards:

   a. American National Standards Institute (ANSI)
   b. BOCA National Building Code
   c. Code of Federal Regulations (CFR)

      1) 47 CFR 68 Federal Communications Commission (FCC) Rules and Regulations

d. National Fire Protection Association (NFPA)

1) 70 National Electrical Code (NEC)

2) 75 Protection of Electronic Computer/Data Processing Equipment

3) 262 Method of Test for Fire and Smoke Characteristics of Wires and Cables

e. Underwriters Laboratories, Inc. (UL)

1) 910 Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air

f. BICSI

1) Telecommunications Distribution Methods Manual (Latest Issue)

2) NECA/BICSI 568-2001 NEIS Standard for Installing Commercial Building Telecommunications Cabling.

g. American National Standards Institute/Electronic Industries Association/Telecommunication Industries Association (ANSI/EIA/TIA)

1) 568-C.1 Commercial Building Telecommunications Wiring Standard – Part 1: General Requirements

2) 568-C.2 Commercial Building Telecommunications Cabling Standard – Part 2: Balanced Twisted Pair Cabling Components

3) 568-C.3 Optical Fiber Cabling Components Standard

4) 569-B Commercial Building Standards for Telecommunications Pathways and Spaces (December 2001)

5) 606-A The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

6) 607 Commercial Building Grounding and Bonding Requirements for Telecommunications

7) 758 Customer-Owned Outside Plant Telecommunications Cabling Standard

8) 942 Telecommunications Infrastructure Standard For Data Centers

h. International Standards Organization/International Electrotechnical Commission (ISO/IEC)

1) 11801 Generic Cabling for Customers.

i. National Electrical Manufacturers Association

1) NEMA WC66 Performance Standards for Category 6 and Category 7 Shielded and Unshielded Twisted Pair Cables

1.5 Coordination

A. Coordinate arrangement, mounting, and support of communications equipment so connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices with other trades.

C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed.

D. Coordinate sleeve selection and application with selection and application of firestopping.

1.6 Warranty

A. Materials and workmanship hereinafter specified and furnished shall be fully guaranteed by The Vendor for one year (365 calendar days) from transfer of title against any defects. Defects which may occur as the result of faulty materials or workmanship within one year after installation and acceptance by the Construction Manager shall be corrected by the Vendor at no additional cost to the Owner. The Vendor shall promptly, at no cost to the Owner, correct or re-perform (including modifications or additions as necessary) any nonconforming or defective work within one year after completion of the project of which the work is a part. The period of The Vendor's warranty(ies) for any items herein are not exclusive remedies, and the Owner has recourse to any warranties of additional scope given by The Vendor to Owner and all other remedies available at law or in equity. The Vendor's warranties shall commence with acceptance of/or payment for the work in full.

B. All associated hardware and labor shall have a manufacturer and/or supplier's warranty for a minimum period of twenty (20) years from the date of acceptance by the Owner. This warranty must guarantee the fiber optic cable performance parameters that meet or exceed those specified in TIA/EIA 568-B for the category of wire specified and offer an assurance for any application that is designed to operate on over the specified cable. This is to include the replacement of any defective components provided as part of this project at no cost to Owner for either parts or labor.

C. The fiber optic cable manufacturer shall provide a written application assurance warrantee that the OM4 fiber optic cable shall support 10G Ethernet to 550 meters. Manufacturer must provide on-site technical assistance for non-operational links that are within the parameters of the assurance guarantee at no cost to the Owner.

D. These warranties shall in no manner cover equipment that has been damaged or rendered unserviceable due to negligence, misuse, acts of vandalism, or tampering by Owner or anyone other than employees or agents of The Vendor.

E. Insurance covering said equipment from damage or loss is to be borne by The Vendor until full acceptance of equipment and services.

Part 2 Products

Not used.

Part 3 Execution

3.1 Common Requirements For Communications Installation

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 Sleeve Installation For Communications Penetrations

A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting 1” proud with both surfaces of walls.

F. Extend sleeves installed in floors 6 inches above finished floor level.

G. Size pipe sleeves to provide a maximum of 40% fill, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint.

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Note existing penetration that are not properly sealed for future reference.

K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 Sleeve Seal Installation

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 Firestopping

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly.

3.5 Conduit Pathways

A. Conduit pathways shown on drawings are existing. If additional conduits are required due to blockage, the owner will provide any additional conduit paths for communications.

B. Installer must provide sufficient advanced notice of insufficient conduit paths to allow scheduling of the installation without incurring project delays.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes:

1. Telecommunications mounting elements.
2. Telecommunications equipment racks and cabinets.
3. Grounding.

1.2 Submittals

A. Submit per the requirements of Division 01.

B. Action Submittals:

1. Product Data: For each type of product.
   a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
   b. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
   a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   b. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
   c. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

C. Informational Submittals:

1. Qualification Data: For layout technician, installation supervisor, and field inspector.

D. Closeout Submittals: Operation and Maintenance Manuals.

1.3 Quality Assurance

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

1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of either a BICSI Level 2 Installer or a Certified Installer by the manufacturer of the proposed termination products, who shall be present at all times when Work of this Section is performed at Project Site.

3. Field Inspector: Currently registered by BICSI as RCDD or ITS Technician to perform the on-site inspection.

B. 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.

C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-B.

D. Grounding: Comply with ANSI-J-STD-607-A.

1.4 Project Conditions

A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.5 Coordination

A. Coordinate layout and installation of communications equipment with other trades. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Construction Manager to exchange information and agree on details of equipment arrangements and installation interfaces.

2. Record agreements reached in meetings and distribute them to other participants.

3. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

Part 2 Products

2.1 Pathways

A. General Requirements: Comply with TIA/EIA-569-B.

B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.

1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.

2. Support brackets with cable tie slots for fastening cable ties to brackets.

3. Lacing bars, spools, J-hooks, and D-rings.

4. Straps and other devices.

C. Ladder Racks:

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

   a. Commscope.
   b. Cooper B-Line, Inc.

2. Cable racks/runways shall be constructed of solid steel side bars in widths indicated.

3. Rung spacing shall be 9 inches on centers, typical.

4. Cable racks/runways and connecting and mounting hardware shall be of uniform manufacture.

5. Finish: Black, baked-polyester powder coat.

2.2 Equipment Frames

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.

2. Chatsworth.

3. Hubbell Premise Wiring.

4. Ortronics, Inc.

5. Or approved equivalent.

B. General Frame Requirements:

1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.

2. Module Dimension: Width compatible with EIA 310 standard, 19-inch panel mounting.

3. Finish: Black, baked-polyester powder coat.

4. Height: 42RU.

C. Floor-Mounted Racks: Modular-type, aluminum construction.

1. Equipment mounting racks shall be free-standing aluminum relay racks with predrilled and pretapped uprights, drilled and tapped on both sides. Rack bases shall be predrilled to allow floor fastening.

2. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug.

3. Baked-polyester powder coat finish.

4. Minimum vertical rail depth shall be 6 inches.

D. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.

2. Baked-polyester powder coat finish.

3. Vertical Cable Management:

   a. Vertical wire managers shall have front and rear channels, with covers.
   b. Vertical wire managers shall be devices specifically manufactured for the purpose of routing cables, wires and patch cords vertically on 19-inch equipment racks.
   c. Vertical wire mangers between two racks are to have a minimum of 6 inches of available space and capacity for 250 Category 6 Patch Cords.
   d. Vertical wire mangers at the end of a single rack are to have a minimum of 6 inches of available space and capacity for 150 Category 6 Patch Cords.
   e. Vertical wire managers shall have individual 'fingers' that guide patch cords from each rack unit and these 'fingers' shall extend to the same extent as the patch panels.
   f. Vertical wire managers shall mount to racks by bolts and/or nuts and lockwashers.
   g. Acceptable Manufacturer: Commscope, Hubble or the proposed equipment rack/cabinet manufacturer.

4. Horizontal Cable Manager:

   a. Provide at the top of each relay rack and between patch panels as shown.
   b. Rack-mounted wire managers shall be devices specifically manufactured for purpose of routing cables, wires and patch cords vertically and horizontally on 19 inch equipment racks.
   c. Rack-mounted wire managers shall consist of ring or bracket-like devices mounted on rack panels for horizontal distribution, and on panels or individually mounted for vertical distribution. Rack-mounted wire managers shall mount to racks by screws and/or nuts and lockwashers. Self-adhesive mounting is unacceptable.
   d. Steel rings on wire managers shall be 4 inches deep by 3.5 high and have a manufacturer's fill capacity of 60 Category 6A cables.
   e. Rack-mounted wire managers shall be manufactured by Ortronics or Hubble.

5. Cabinet Level Power Distribution.

2.3 Grounding

A. Provide No 6 AWG solid conduction cable with Green insulation and appropriate grounding lugs for the Cabinet/Racks provided.

B. Connect each Rack/Cabinet to Ground Bus Bar individually.

2.4 Labeling

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

Part 3 Execution

3.1 Installation

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

D. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.2 Equipment Rack Installation

A. Bolt equipment racks to floor.

B. Racks shall be installed level.

C. Wire managers shall be bolted or screwed to racks. Do not use adhesive mountings.

D. Ganged racks shall be bolted together.

E. Ground individual racks.

3.3 Ladder Rack

A. Install ladder rack approximately 85 inches AFF.

B. Secured ladder rack to the equipment racks and room walls.

C. Support ladder rack at a maximum of 10 foot intervals with trapeze supports suspended from ceiling.

D. Bolt ladder racks vertically to walls with 1 inch stand-offs, as shown on drawing, to support cables transitioning from floor.

E. Provide radius drops where cables rout into equipment racks.

F. Utilize manufacturer’s fittings and accessories as required for installation to meet the manufacturer’s recommended installation procedures.

3.4 Firestopping

A. Comply with TIA/EIA-569-B.

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 Grounding

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor. Provide a separate ground cable for each cabinet/rack. Do not daisy chain cabinet/rack grounds.

1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.6 Identification

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. For fire-resistant plywood, do not paint over manufacturer's label.

B. Each Equipment Rack in the Telco Rooms and IDFs will be labeled with room ID-Rack Number

1. Room Identifier is a letter and is marked on the door frames.

2. Rack Number will be the row and position in row.

   a. Row number will be a Letter with ‘A’ closest to the door.
   b. Position numbers are provided on Telecommunication drawings.

3. Example: A-A3.

C. Labels will be a minimum of 1/2 inch high and mounted on the front and back of each cabinet/rack.

D. Labels shall be preprinted or computer-printed type.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes:

1. UTP cabling.
2. Cable connecting hardware, patch panels, and cross-connects.
3. Telecommunications outlet/connectors.
4. Cabling system identification products.
5. Cable management system.

1.2 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: Submit complete engineering data showing compliance with details of each Product's Specification. No substitutions will be accepted unless approved at bid time. An Equipment Cover Sheet shall be marked for clear identification of the following information, except as noted:

1. Project name and phase, as applicable.
2. Contractor's name.
3. Date of submission.
4. Page and paragraph number of Contract Specification Section to which particular equipment applies must be written on each data sheet.

C. Samples: As follows:

1. One (1) of each outlet type with faceplates.
2. One (1) of each cable support component, except conduit.
3. One (1) 3-foot length of each cable type.
4. One (1) of each type of patch cord.

D. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

2. Cabling administration drawings and printouts.

E. Closeout Submittals: Operation and Maintenance Manuals.

1.3 Definitions

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

B. IDC: Insulation displacement connector.

C. WAO (Work Area Outlet)/Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

D. UTP: Unshielded twisted pair.

1.4 Administrative Requirements

A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.5 Horizontal Cabling Description

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. Horizontal cabling shall contain no transition or consolidation points between the horizontal cross-connect and the telecommunications outlet/connector.

2. Bridged taps and splices shall not be installed in the horizontal cabling.

3. The maximum allowable horizontal cable length is 295 feet.

1.6 Performance Requirements

A. General Performance: Horizontal cabling system shall comply with the Category 6 transmission standards in TIA/EIA-568-C.1, when tested according to test procedures of this standard.

1.7 Quality Assurance

A. Contractor Qualifications:

1. Contractor must own and maintain tools and equipment necessary for successful installation and testing of optical and Category 6, metallic premise distribution systems and have personnel who are trained in the use of such tools and equipment.

2. Contractor must regularly install communications cable systems of size, scope and complexity of this Project for a period of not less than one (1) year and at the time of bidding, must be certified by the manufacturer of the termination products proposed and capable of providing a manufacturer's warranty.

3. Installation of cables, connectors and testing shall be accomplished by technicians who have been:

   a. Regularly installing communications cable systems of size, scope and complexity of this Project for a period of not less than two (2) years, or
   b. Regularly installing communications cable systems of size, scope and complexity of this Project for a period of not less than one (1) year and completed a communication's cabling training program.

4. Installation/Testing Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project Site.

B. 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.

C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-B.

D. Grounding: Comply with ANSI-J-STD-607-A.

1.8 Coordination

A. Coordinate layout and installation of telecommunications pathways and cabling with other trades.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

Part 2 Products

2.1 General

A. Products and manufacturers specified represent the minimum quality required. Unless expressly prohibited, substitutions for equipment manufacturers must be submitted for review with the bid; otherwise, no substitutions will be accepted.

B. All products shall be UL listed or classified.

C. Cable within ceiling spaces, where not in conduit, shall be supported by a system manufactured specifically for cable support.

D. All firewall penetrations shall be firestopped with applicable material to maintain the fire rating of the penetrated wall.

E. Horizontal Workstation Distribution:

1. Each Workstation Outlet shall include one (1) 4-pair receptacle for voice and one (1) 4-pair receptacles for data services, as shown, mounted in a single-gang faceplate as shown. Refer to Drawings for complete listing of outlet types.

2. Cable to each Workstation Outlet shall include two (2) Category 6 unshielded, twisted, 4-pair, cables. Refer to drawings for listing of cable and termination requirements.

3. Cable routing shall be a ceiling floor distribution systems.

2.2 Pathways

A. General Requirements: Comply with TIA/EIA-569-B.

B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.

2. Lacing bars, spools and J-hooks.

3. Cable tray as shown.

4. Cable within ceiling spaces, where not in conduit, shall be supported by a system manufactured specifically for cable support.

2.3 UTP Cable

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

1. Mohawk M58281RB - M58292RB

B. Description: 100-ohm, 4-pair UTP

1. Comply with ICEA S-90-661 for mechanical properties.

2. Comply with TIA/EIA-568-C.1 for performance specifications.

3. Comply with TIA/EIA-568-C.2, Category 6.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

5. Color:

   a. Blue jacket for primary data connections.

2.4 UTP Cable Hardware

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

   1. Hubble.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Workstation Outlet Assembly:

   1. Workstation outlet shall be of a modular design allowing for a minimum of four (4) port positions that can be configured with various snap-in connector types or blank inserts for custom arrangements. 8P8C connector jack shall be separately color-coded or contain an icon identifying outlet as serving data or voice devices. Each designated workstation shall have 8P8C connector jacks, minimally rated for Category 6 performance, installed in a faceplate, with appropriate blank inserts.

   2. Faceplates and retaining and mounting plates shall be White.

   3. Receptacle wire terminations shall be insulation displacement type. Wiring configuration shall be TIA/EIA 568-C.1 T568B.

   4. Each receptacle module shall be removable from faceplate. Faceplate shall contain a recessed labeling area. Wall-box-mounted outlet assembly faceplates shall extend no more than 7/8 inch from wall.

   5. Twisted-pair receptacle module characteristics shall be as follows:

      a. Number of contacts: 8.
      b. Wire termination: Insulation Displacement Connector (IDC).
      c. Wiring configuration: T568B.

   6. Electrical characteristics shall meet or exceed TIA/EIA Commercial Building Telecommunications Cabling Standard 568-C.1 and 568-C.2 for connecting hardware, and FCC Part 68 Rules and Regulations.

   7. Workstation outlets for permanent partitions shall be Hubble NEXTSPEED® Category 6 to match existing.

D. Modular Patch Panels for UTP Wiring:

1. Modular patch panels shall be rack mountable with 8-position, 8-contact modular plugs on panel front. Rear panel terminations shall be 110-type. Panels shall be EIA 19 inch rack width and 2 Rack units in Height.

2. Modular patch panels shall each have 48 ports with each port jack connected to the 110-type terminations with 8 wires in TIA/EIA 568-C.2 T568B wiring configuration.

3. Patch panels must have sufficient space between ports to accept patch cords in every port without the removal of the anti-snag boot.

4. Modular patch panels shall exceed all TIA/EIA Category 6 criteria.

5. Modular patch panels shall be Hubble NEXTSPEED® Category 6 to match existing.

2.5 Floor Box Twisted-Pair Outlets

A. Floor box twisted-pair outlets shall mount in standard electrical duplex outlet wall plate. Each outlet assembly shall accommodate four (4) data receptacles. Terminations shall be 110-Type insulation displacement connectors.

B. Assembly shall have capacity for four (4) 8-conductor receptacles wired.

C. Receptacle wire terminations shall be 110-type insulation displacement type. Wiring configuration shall be TIA/EIA 568-C.1 T568B.

D. Outlet mounting frame shall be QUAD 106 Style matched to the workstation jacks.

E. Workstation Outlets shall be provided for each floorbox.

F. Receptacles and retaining and mounting plates shall be coordinated with electrical faceplate.

2.6 Wall Mounted Telephone Outlets

A. Telephone wall outlets shall have the following characteristics:

1. Number of Contacts: 8.

2. Keying: RJ45.

3. Wire termination: Insulation Displacement Connectors (IDC).

B. Provide single jack without faceplate.

C. Jack shall be from the Ortronics or Hubble series of components.

2.7 UTP Patch Cords

A. UTP patch cords shall have RJ-45 connectors at each end with a strain relief and an anti-snag guard. UTP patch cords shall be factory fabricated; field fabrication is expressly prohibited.

B. UTP patch cords shall be constructed with stranded cordage.

C. Provide one (2) UTP patch cords for each WAO cable matching the cable color with an additional 10 percent spare UTP patch cords.

D. UTP patch cords shall be manufactured by same manufacturer terminating hardware and must be matched to performance of that hardware.

2.8 Grounding

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.9 Identification Products

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Identification for Electrical Systems: Division 26.

2.10 Recessed Poke-thru

A. Multi-service recessed poke-thru device.

B. Features:

1. Complies with UL514A and/or UL514C.

2. Conforms to NEC Section 300-21.

3. Insert:

   a. Shall recess the devices a minimum of 2-3/4 inches (69 mm) and have a polyester based backing enamel finished interior (ivory).
   b. There shall be the necessary channels to provide complete separation of power and communication services.
   c. Body will consist of an intumescent fire stop material to maintain the fire rating of the floor slab.
   d. Shall have an integral retaining feature that will hold the body in place without additional fasteners.
   e. Shall include three compartments allowing up to three duplex outlets or a mixture ac power, tele/data, and audiovisual connections.
   f. Shall include a 3/4” trade size conduit stub connecting the body to a 25.5 cu. In. stamped steel junction box for wire splices and connections.

4. Activation Cover:

   a. Shall be manufactured from die-cast aluminum alloy and be available in powder-coated gray, black, or plated in brass, nickel or bronze finish.
   b. The activation cover shall be 7-1/4 inches (184mm) in diameter. The activation covers shall be available in carpet and tile versions.

5. Acceptable Products:

   a. Wiremold Evolution 6AT assembly.
   b. Recessed Prewired Audio/Video Assembly with Disposable Plate (P/N: 6ATCPAV**) includes:

      1) 20-Amp Duplex Receptacles for side compartment (P/N: 68REC).

      2) 2-port communications insert for side compartment (P/N: 682A).

      3) 1-gang AV device mounting plate for center compartment (P/N: 6MAAP).

      4) Half-gang 2/4” trade size conduit housing assembly for side compartment (P/N: 575CHA).

      5) Half-gang pass-thru housing assembly for side compartment (P/N: 5PTHA).

      6) 1-gang past-thru housing assembly for center compartment (P/N: 1PTHA).

C. One surface style Die-cast aluminum cover available in finishes(**): Black (BK), Gray (GY), Nickel (NK), Brass (BS), or Bronze (BZ); coordinate with owner.

2.11 Flat Panel Back Box

A. Retro-fit Pre-wire In-wall Box.

B. Features:

1. Installs between 16” centers.

2. Includes four (4) knockouts for metal retrofit, single gang junction boxes.

3. Includes four (4) knockouts for 1/2” EMT conduits.

4. UL Listed.

C. Acceptable Products:

1. Chief PAC 511.

2. Approved Equal.

Part 3 Execution

3.1 Wiring Methods

A. Wiring Method: Install all systems in accordance with manufacturer’s printed instructions, as well as all Local, State and National codes and standards.

B. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Comply with requirements for raceways and boxes specified in Raceway and Boxes for Electrical Systems: Division 26.

C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. 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.

3.2 Installation Of Pathways

A. Pathway Installation in IDF Rooms:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Install ladder rack approximately 85 inches AFF, secured to the equipment racks and room walls. Suspend trapeze supports from ceiling.

B. Pathway Installation outside Communications Equipment Rooms:

1. Suspend UTP cable not in a cable tray or pathway, 8 inches above ceilings by cable supports not more than 60 inches apart.

2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

3.3 Installation Of Cables

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-C.1.

2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

3. Install 110-style IDC termination hardware unless otherwise indicated.

4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

5. Install lacing bars on rear of patch panels to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

6. 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.

7. 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.

8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

9. Cable shall not be stressed such that twisting, stretching or kinking occurs.

10. In buildings with more than one communications closet serving a floor, coverage areas of each closet shall not overlap.

11. Route all cables at right angles to the building structure.

12. Do not exceed the manufacturer's recommendations for fill when utilizing j-hooks.

13. Fasten cables on vertical runs to cable trays every 18 inches.

14. Cable that is routed outside the building envelope, within conduit that is in direct contact with earth or exposed to the elements shall be have a water blocking element incorporated into the cable construction and be rated for the route.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-C.2.

2. Rated pulling tension of cable shall not be exceeded.

3. Station cable routed overhead that is not in a conveyance system (conduit, cable tray) shall be suspended a minimum of 8 inches above ceilings by cable supports not more than 5 feet apart. Workstation cable shall not come in contact with lighting fixtures, steam pipes or potentially damaging items in ceiling spaces. Cables shall not be run through structural members, pipes or ducts to support cable. Cable support devices may be attached to structural members. Keep twisted-pair cables a minimum of 12 inches from parallel power conductors. Avoid placing station cable parallel to power conductors.

4. Total length of station cables between outlet and connecting blocks shall not exceed 295 feet or 90 meters.

5. All station cable shall be installed in "home run" fashion.

6. Cable bend radius shall not be less than:

   a. Four (4) times the outside diameter of UTP cable when it is at rest (post pull).
   b. Eight (8) times the outside diameter of UTP cable when it is under stress (pulling).

7. Maintain termination position consistency for each workstation service cable. Relative position shall be maintained on each termination block.

8. The cable jacket is to be labeled within 6 of each end, installed after trimming and removal of the sheath. This label will contain the room number of the wiring closet, the outlet jack position and the cable run number. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties.

9. Outlet faceplates and Patch Panels shall be identified with a machine-generated label. This label will contain the room number of the wiring closet where the other end is terminated, and the cable run numbers identified for Copper terminations. The label will be printed on the jack in the format specified below. Attach faceplate labels in spaces provided.

10. Cable and wires shall not run on floors in communications closets.

11. Provide a 6-inch service loop on each twisted pair cable within each outlet box.

12. Provide 6 feet of slack in a wiring closet when cables will terminate onto an equipment rack. Lace and coil all slack to eliminate tangle.

13. Remove no more than one 1 inch of station cable jacket at termination points. Each wire pair twist shall be maintained up to the termination point. The maximum allowable amount of untwist is 3/8 inch.

14. Cable ties shall be loosely wrapped about the cable bundle so as not to distort cable geometry.

15. Bundle cables with Velcro wraps within Telecommunications Rooms and the Data Center Rooms to organize cables into bundles.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

4. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

5. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 Firestopping

A. Comply with TIA/EIA-569-B.

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 Grounding

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 Identification

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Administration Class: 1.

2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. 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 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.

C. Cable and Wire Identification:

1. Label each cable within 6 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Label each Rack, Cabinet, Tray Segment and Conduit in accordance with Sections 271100.

3. Label each unit and field within distribution racks and frames in accordance with Sections 271100.

4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.

5. Label each work area outlet jack position with the rack identifier which contains the room identifier, panel identifier and port number for the other terminated end. (Example AA-1A36)

D. 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, for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.7 Field Quality Control

A. Materials and documentation provided shall be subject to inspections and tests. Equipment and systems will not be accepted until all required inspections and tests have been made, demonstrating that equipment and systems conform to Specifications, and that required equipment, systems, and documentation have been provided. Owner's Representative reserves right to request additional tests at no additional cost on any Work that Owner's Representative determines not to be in accordance with this Specification.

B. Owner's Representative shall have access to inspect supplier and installer's quality assurance (QA) standards, procedures, and records that are applicable to this Project. Inspection shall not relieve supplier or installer of requirement for providing material and equipment conforming to this Specification.

C. Notify Owner's Representative in writing of test schedule at least two (2) weeks in advance. Test schedule shall be coordinated with Owner's Representative.

D. Tests and Inspections:

1. Visually inspect UTP 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-C.1.

2. Visually confirm specified Category marking of outlets, cover plates, outlet/connectors, and patch panels.

3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

4. UTP Performance Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C.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.

b. Test each outlet. Perform the following tests according to TIA/EIA-568-C.1 and TIA/EIA-568-C.2: Basic link shall be tested to TIA/EIA Category 6 requirements.

c. One hundred percent of the installed cabling links must pass the requirements of the standards mentioned above. Marginal pass (PASS*) are only acceptable for cables that are within the margin of error for length. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance paragraph below.

d. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Warranty and Service:

1. Warranty: Communications cabling systems shall be guaranteed in writing against defects in workmanship and defective materials for a period of one (1) year after acceptance. During this time, communications cabling systems shall be kept in proper operating condition at no additional cost.

2. Associated hardware and labor shall have a manufacturer and/or supplier's warranty for a minimum period of twenty (20) years from date of acceptance by Owner. This Warranty must guarantee channel and link performance parameters that meet or exceed those specified in TIA/EIA 586-B and offer an assurance for any application that is designed to operate on Category 3, 5e or 6 copper. This is to include replacement of any defective components provided as part of this Project at no additional cost to Owner for either parts or labor.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Applicable provisions of the Conditions of the Contract and Division 01, General Requirements, govern work in this Section.

B. Section Includes: The provision of all plant, materials, labor and equipment and the like necessary and/or required for the complete execution of all audiovisual equipment and related work for this project as required by the schedules, keynotes and drawings, including, but not limited to the following:

1. Unless otherwise specified, supply only new equipment, parts and material, and protect all equipment from construction dust and debris until final acceptance. Operate only as required for testing as part of installation procedure. Provision of all manufactured components, installation, wiring, and testing is the responsibility of a single contractor.

2. The system drawings indicate the general layout of the various items of equipment and their functional relationships. However, layout of equipment, accessories, and conduit systems are diagrammatic unless specifically detailed and do not necessarily indicate every item required for a complete installation. Provide any incidental equipment needed in order to result in a complete and operable system even if not specified or shown on drawings without claim for additional payment.

3. Quantities of all major installed and all portable equipment, including any add- or deduct-alternates, are indicated on the system and electrical drawings. Quantities of portable equipment are indicated in schedules contained in the drawings or specifications; quantities of installed equipment are determined by examining the functional diagrams, plans, and riser diagrams.

4. Refer to audiovisual conduit drawings for receptacle backbox location and quantity information. Also refer to architectural reflected ceiling plans for exact location of ceiling-mounted devices. Coordinate final locations with owner and AV consultant.

5. Verify correctness of parts lists and equipment model numbers and conformance of each component with manufacturer's specifications.

6. Obtain all permits necessary for the execution of the work. Comply with all applicable local codes and regulations.

7. Supply and install all miscellaneous conduit and wireways required to provide a complete and operable system.

C. Functional Requirements of Systems:

1. Building Audio System:

a. General:

1) The system will make use of a building-wide digital networked audio routing and control infrastructure based on the CobraNet standard. In general, the existing analog audio input cabling within the Main Building will be maintained. Networked Audio interface, processing, and amplification will be added to the existing Main, Mezzanine, Ballroom Stage (Storage), and Lecture Hall projection Room and linked via Core Ethernet Switches to be added to the Main Equipment Room (37W162) and the Expansion AV Master Control Room. This Audio Network will be fully independent of the building Ethernet in order to reduce network congestion. Temporary use of CobraNet devices through the building Ethernet network will be possible through a configured Virtual LAN connection. An additional VLAN will be provided for non-audio control data communication between Audio System components And the AV Control System

2) A secondary monitoring interface with the building Fire Alarm System will be included within the Main building. The FA monitoring will mirror the functionality provided in the Expansion system. At present, the duplicate audio inputs and outputs are not included in the upgrade design. Emergency paging signals from the Fire Alarm System will override all active speech and program audio in the system for the duration of the emergency condition. Components critical to this functionality will be fully redundant and fault-tolerant, including the core and edge switches, networked power amplifiers and fiber optic interconnecting cabling. The Audio System and associated Control System will constantly monitor system conditions (including device and network failures, power loss, amplifier load monitoring, and UPS status) and report faults to the Fire Alarm System. Use of a 19KHz pilot tone will enable 24/7 monitoring of amplifiers and loudspeaker circuits.

3) A centralized AV Control System will be included to provide user interface with the Audio System. Primary control and configuration will be through web-based “Virtual Touchpanels” accessible to technicians via network-connected laptops, netbooks, and/or personal communications devices. Additional control processors and touch panels will be deployed in the AVMC and the Main AV Equipment Room (37W162) in the original building. All new and existing control systems /touch panels are to be are to operate the entire property-wide AV system upon completion.

b. Meeting Room:

1) Provide a high-output audio system for speech reinforcement and program audio playback through existing ceiling-mounted loudspeakers.

2) Verify existing cable runs for continuity. Confirm termination integrity at wall plates and identify/track cable routing and terminations at remote equipment racks, e.g., patch panels, etc.

3) In addition to the local inputs provided within a given Meeting Room, each room is to have feeds for Building Wide (general) paging, three (3) channels of Background Music (BGM), audio tie line (In/Out) to new 96x96 mono matrix switch, pre-recorded messaging/ad hoc client paging, and FA / Emergency announcements. Provide

audio ducking, as needed. Update DSP programming for the Expansion project to include these features, as needed.

4) Existing loudspeakers will be retained except where found to be defective. The contractor is to promptly notify the Convention Center and AV Consultant. Contractor is to provide a proposal to repair or replace any defective unit.

c. Exhibit Halls (First Floor, Second Floor):

1) Provide a high-output audio system for speech reinforcement, paging, and announcements through pendant-mounted loudspeakers.

2) Inputs to the system will be provided through VLAN connections in the Exhibit Halls with the use of audio network interface devices. Existing analog inputs will be retained and included as an input to the digital audio system for Exhibit Halls A, B, C, and F (former D).

3) Loudspeakers in the original Exhibit Halls (Halls A, B, and C) have been moved to the Expansion system. Certain periphery areas, e.g., soffits, restrooms, etc. were not included in the previous transition. Care will be needed when programming sources and level control for these areas.

4) In addition to the local inputs provided within a given area, each room is to have feeds for Building Wide (general) paging, three (3) channels of Background Music (BGM), audio tie line (In/Out), pre-recorded messaging/ad hoc client paging, and FA / Emergency announcements. Provide audio ducking, as needed. Provision for a network microphone preamp input is required. Update DSP programming for the Expansion project to include these features, as needed.

5) A message server (ADD/ALT) and portable desktop announcement stations will allow clients to activate pre-recorded messages and/or record/playback ad hoc announcements. The allocation of the particular desktop unit to a specific area of the building will be managed by the AV Control system.

d. Ballrooms (Fifth Floor):

1) Provide a high-output audio system for speech reinforcement and program audio playback through ceiling-mounted loudspeakers.

2) The existing analog inputs will be retained. Six (6) poke-thru devices with two data connections and a duplex AC outlet will be added by others; provide each with two (2) microphone inputs. Coordinate locations with the PA Convention Center and the AV Consultant.

3) In addition to the local inputs provided within a given area, each room is to have feeds for Building Wide (general) paging, three (3) channels of Background Music (BGM), audio tie line (In/Out), pre-recorded messaging/ad hoc client paging, and FA / Emergency announcements. Provide audio ducking, as needed. Provision for a network microphone preamp input is required.

4) Loudspeaker output is to be set-up with capabilities present in the current system. A configuration/control matrix is included in the design drawings.

2. Audio and Video Distribution and Infrastructure:

a. The audio capabilities of the existing Central Record Room (Main Building) will be retained. The Expansion's Record Room will be upgraded to allow audio recording of all Main Building systems.

b. A series of receptacle panels will be provided with audio outputs from the AV Master Control Room.

c. A 96x96 mono audio matrix switch with connection to the digital audio system and audio patch panels will provide flexible cross connection between all spaces within the property.

3. Digital Signage System:

a. The Main Building renovation project will include additional components added to the Digital Signage System in place in the existing Convention Center. Provide Displays, Media Players, and mounting hardware in locations shown on the AV drawings. Coordinate with architectural details. New displays are to be connected to the building Ethernet network and configured on a dedicated Digital Signage VLAN. Provide all software licensing necessary to support the additional displays.

D. Related Work Specified Elsewhere:

1. Communications Horizontal Cabling: Division 27.

E. Definitions:

1. XLR Connectors and Receptacles: Connectors and receptacles conforming to proposed E.I.A. Standard RS-297-B referred to as "XLR"-type connectors and receptacles.

2. Units and Symbols: Metric units according to the System of International Units (SI) are used as well as other common units and symbols.

3. Octave and 1/3-Octave Bands: Centered on ANSI preferred frequencies.

4. Sound Level Meter and Filter Set: Calibrated ANSI Type 1 meter with ANSI S1.11-1966 1/3 octave band filters.

5. Pink Noise: Constant energy in constant percentage bands, random or quasi-random noise.

6. Loudspeaker Power Rating: Based on pink noise test signal with 6 dB peak-to-average ratio, bandwidth as stated.

7. Loudspeaker Coverage Pattern: Nominal angular coverage included at -6 dB points relative to axial response, bandwidth as stated.

8. DI: Axial directivity index.

9. Loudspeaker Sensitivity: Axial level in dB with 1 watt input at 1 meter distance.

10. Microphone Sensitivity: Level in dB re 1 milliwatt into rated impedance at 1000 Hz (or as otherwise stated) and 94 dB SPL. (10 dynes/cm^2 or 1 Pa).

11. SPL: Sound pressure level in dB re 0.00002 Pa (0.0002 microbar).

12. Power Amplifier Output Power Rating: Based on continuous average sine wave test signal. Load impedance and bandwidth as indicated.

13. Amplifiers and Signal Processors: Frequency Response, Distortion, and Hum and Noise re full rated output level.

1.2 Bid Submittals

A. Instructions to Bidders: To be considered, Bids must be made in accord with the Design Professional's Instructions to Bidders and this Article.

B. Examinations: Carefully examine the contract documents and the construction site to obtain first-hand knowledge of existing conditions. Contractors will not be given extra payments for conditions that can be determined by examining documents or site and will not be relieved of any obligations with respect to bid.

C. Questions: Submit all questions about the contract documents in writing. Replies requiring changes to the contract documents will be issued to all bidders as addenda and will become part of the Contract. The Design Professional and Owner may give but will not be responsible for oral clarifications. Questions received less than 10 days before bid date cannot be answered in writing.

D. Acceptable Products: Model numbers and manufacturers identified herein indicate a standard of quality and performance. Other products will be considered subject to approval of complete technical data, samples and results of independent testing of proposed equipment, submitted in accordance with the “Substitutions” section below.

E. Substitutions: To obtain approval for substitutions and for items identified as "approved equal", submit written requests at least 10 days before bid date. Requests received after this time will not be considered. Requests shall clearly describe the product for which approval is asked, including all data necessary to demonstrate acceptability. If the product is acceptable, an Addendum may be issued to all bidders.

F. Equipment Availability: Verify with manufacturers availability and cost of all equipment proposed, including equipment specified herein. No cost increases will be allowed for manufacturers' cost increases, or for substitutions required because of unavailability of proposed equipment.

G. Basis of Bids:

1. Include a complete itemized list for each base-bid system indicating the manufacturer, model number, unit cost and total costs for all specified items. Itemization of miscellaneous equipment such as cable, switches, and receptacles is not required.

2. Clearly indicate the total cost, including all expenses, for each individual system to allow the Owner to select any or all to be included in the contract. Itemization of miscellaneous equipment such as cable, switches, and receptacles is not required.

3. Organize each list with the information presented, in the order that it appears in this specification, in 6 columns from left to right:

   a. Paragraph number as it appears in this specification.
   b. Paragraph title as it appears in this specification.
   c. Manufacturer and model number.
   d. Quantity.
   e. Unit Cost.
   f. Extension (unit cost times quantity).

4. At the end of each list indicate the cost of all other items such as for miscellaneous equipment, engineering, installation labor, overhead, taxes, etc.

5. On a separate list indicate costs of any specified add- or deduct-alternates with the information presented in the same manner as for the base-bid system.

6. Include a listing of any voluntary alternates proposed by the bidder as substitutions or additions to the specified systems.

7. Include any notes or comments if necessary to qualify the bid.

8. Identify any sub-contractors and indicate the work they are to do.

9. Provide documentation of ability in installing similar systems. Furnish the names, addresses and telephone numbers of the System Designer, Design Professional, General Contractor and Owner on three projects similar in scope, which the Contractor has installed within the last 5 years.

10. Include certification of ownership and full familiarity with the operation of the following minimum test equipment. Provide a list of the manufacturer, model, and serial number for each item of test equipment required.

    a. Low distortion sine wave oscillator.
    b. Distortion analyzer.
    c. AC impedance bridge.
    d. Oscilloscope.
    e. Sound level meter, 1/3 octave band real time audio analyzer and pink noise generator.
    f. Multimeter.
    g. Cable Tester (suggested: Sescom CT-7).
    h. Video waveform monitor, vectorscope, and signal generator.
    i. Photometer with luminance and illuminance probes.
    j. 1/2” type H (VHS) format videocassette test tape: SMPTE V2-RMS-V.
    k. Multi-frequency computer RGB and DVI test pattern generator (suggested: Extron VTG-400DVI).

1.3 Quality Assurance

A. Project Management: Maintain the same person in charge of work throughout installation.

B. Contract Documents: Maintain a complete set of system drawings and specifications at the site at all times during installation.

C. Fabrication and Installation: Fabricate all equipment racks and subassemblies. Make field connections of all audio, video and control wiring including microphone, line level, loudspeaker, video, and control system circuits to equipment, equipment racks and connection panels. Continuously supervise the installation and connections of cable and equipment.

D. Contractor Qualifications: To be considered qualified for this work, the contracting firm must be experienced in the provision of audiovisual systems similar in complexity to those required for this project, and meet the following:

1. The Contractor's primary business is the provision, fabrication and installation of professional audiovisual and related systems.

2. The Contractor has been regularly engaged in the installation and service of professional audiovisual presentation systems for a period of at least five years.

3. The Contractor is an authorized dealer for the major products furnished.

4. The Contractor is an authorized dealer for the specified Audiovisual Control System and factory trained in the installation, maintenance and programming of such systems.

5. The Contractor is, at a minimum, AVSP Sapphire level certified solution provider, with at least 1 CTS-I and 1 CTS (or C-EST) certified employees.

6. At the request of the Design Professional demonstrate the following capabilities:

   a. Adequate plant and equipment to complete the work.
   b. Sufficient staff with appropriate technical experience to oversee and execute the work.

E. Subcontractors: The Contractor may arrange for sub-contract field and special shop work to be done by others.

F. Prime Contractors: Any other installer who intends to bid on this work as the Prime Contractor and does not meet the "Contractor Qualifications" described above shall employ the services of a single "Audiovisual Systems Contractor" who does meet these requirements. The Audiovisual System Contractor shall Furnish and Install the equipment. The Prime Contractor shall clearly identify the Audiovisual Systems Contractor and submit complete qualification information for the Audiovisual Systems Contractor in the Bid. Failure to do so will be cause for rejection of the Bid.

1.4 Substitutions

A. General: The Contractor has the burden of proving, at the Contractor's own cost and expense and to the satisfaction of the Design Professional, that the proposed product is similar and equal to the named product.

B. Basis:

1. Requests for acceptance of proposed equivalents made following the award of bid will be considered by the Design Professional only in the following cases:

   a. The named products cannot be obtained by the Contractor because of strikes, lockouts, bankruptcies or discontinuance of manufacturer and the Contractor makes a written request to the Design Professional for consideration of the proposed equivalent.
   b. The proposed equivalent, in the opinion of the Design Professional, is equal or superior to the named product and its use is to the advantage of the Owner.

2. A formal request must be made for the substitution documenting fully the above reason. Include complete data on the proposed substitution substantiating compliance with the Contract Documents including product identification and description, performance and test data, references and samples where applicable, and an itemized comparison of the proposed substitution with the products specified or named by Addenda, with data relating to Contract time schedule, design and artistic effect where applicable, and its relationship to separate contracts. Accompany the request by accurate installed cost data on the proposed substitution in comparison with the product specified.

C. Consideration:

1. A request for substitution is a representation by the Contractor that:

   a. The Contractor has personally investigated the proposed substitution and determined that it is equal or superior in all respects to that specified.
   b. The Contractor will provide the same warranty for the substitution that would be for that specified.
   c. The cost data presented are complete and include all related costs under this Contract, but exclude costs under separate contracts and exclude Design Professional's re-design costs, and that the Contractor waives all claims for additional costs related to the substitution which subsequently become apparent.
   d. Indicate if there will be any cost impact on work by other trades.
   e. The Contractor will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.

2. An accepted substitution will be documented by Change Order modifying the Specifications. The Contract Price will be changed only if the substitution results in cost savings to the Owner.

1.5 Submittals

A. Shop Drawings and Product Data:

1. The following is required for approval, prior to ordering product, fabrication and installation. Provide three (3) copies unless otherwise specified. Submit complete and at one time. Isolated items will not be considered for approval, except by prior authorization. Rejected items and items requiring correction must be resubmitted at one time, except by prior authorization.

2. The diagrams and details included with these specifications, modified to reflect the stated requirements and to reflect the details of the system as awarded, and including all additional required information, may be used in preparing shop drawings. Drawings that are submitted without the necessary modifications will be rejected.

3. All drawings shall be drawn on a computer-aided drafting (CAD) system.

   a. Bill of Materials and Catalog Data Sheets of all manufactured items. At the end of the Bill of Materials include Catalog Data Sheets ("cut" sheets) for all product arranged in the order listed in the specifications and in the Bill of Materials. Submit in bound form using a 3-ring, GBC or similar binding, and including a cover page identifying the project and submittal. Organize the Bill of Materials with the information presented in the order that it appears in this specification, in 6 columns from left to right:

      1) Paragraph number as it appears in this specification.

      2) Paragraph title as it appears in this specification.

      3) Manufacturer.

      4) Model number.

      5) Quantity.

      6) Comments (if any are needed).

   b. Block diagrams indicating proposed connections of all equipment and indicating equipment types and model numbers.
   c. Equipment/projection/control room layout(s), and equipment rack and cabinet details.
   d. Video Projectors: Provide plan and section drawings verifying image width, lens-to-screen distances and mounting methods. Provide detailed drawings of custom-fabricated or stock mounts and hardware.
   e. Video camera, video monitor, and loudspeaker mounting arrangements.
   f. Shop drawings of any unit, such as control panels, switch panels, or loudspeaker enclosures or grilles, to be fabricated or modified.
   g. Programming instructions for specified Programming Service Company or for AV control system manufacturer if programming is specified to be done by Manufacturer.
   h. Logic and detailed control panel layouts prepared by specified Programming Service Company. Provide page graphics (including text, buttons, colors, images, backgrounds etc.), as well as page flips, sub-pages and overall page logic flow.
   i. Submittals as required by specifications.
   j. Others as required by Design Professional or Consultant.

B. Samples:

   1. Finish for control panels, racks, cabinets, and loudspeaker grilles.

   2. Mechanical connectors for use in wiring.

C. Test Reports: Upon completion of SYSTEM PERFORMANCE TESTS AND ADJUSTMENTS specified in PART 3 - EXECUTION, submit for approval in writing test results including numerical values for all measurements. Also submit written certification that the installation conforms to specifications, is complete and operable, and is ready for FINAL ADJUSTMENTS AND ACCEPTANCE TESTS specified in PART 3 - EXECUTION. Provide three (3) copies unless otherwise specified.

D. Operation and Maintenance Data:

1. Draft Copies: At time of FINAL ADJUSTMENTS AND ACCEPTANCE TESTS specified in PART 3 - EXECUTION, provide draft copies of all specified diagrams, schedules and manuals for inspection during demonstration and acceptance testing. Submit final copies thereafter. All drawings shall be drawn on a computer-aided drafting (CAD) system. For Contractor-prepared drawings, schedules and instructions, provide three (3) draft copies, one (1) final copy for specified mounting, and two (2) final copies for inclusion in specified Complete Instruction and Maintenance Manual, unless a different quantity is otherwise specified.

2. Functional Diagrams: Simplified single line block diagram showing interconnection of all major equipment components and functional relationships. Illustrate all receptacles, patch panel jacks, attenuators, transformers, switches, and loudspeakers. Key each patch panel jack to the patch bay by row and jack number. Diagram shall <u>not</u> illustrate terminal or interconnection cable number designations The Functional Diagram included with these specifications, modified to exclude details, transformer tap designations, etc., and to provide the information described above and any as-built changes, is suitable for this purpose. Complete on a single sheet of minimum size 24" by 36". Mount one photographic, wash-off mylar or rag paper photocopy print of each system behind acrylic at locations to be determined.

3. As-Built Diagrams:

   a. The intent of the diagrams is to provide sufficiently clear and complete information that a technician of average skill may efficiently troubleshoot and service the system, even if unfamiliar with the installation.
   b. Provide drawings showing all terminal blocks, connectors, relays, switches, transformers, attenuators, equipment components, and wires. Label all devices with manufacturer, model number, and reference number (e.g. "SW 15", "TB 6"); reference numbers shall be consistent across all drawings with no repetitions. As a minimum, provide an expanded version of the functional diagrams with cables fanned out at termination points and all labeling as specified above; provide additional drawings where system complexity does not permit complete information to be shown legibly on an individual sheet no larger than the project sheet size. Provide labels for cables continued onto another drawing, indicating termination device, terminal numbers, and drawing sheet on which the termination is shown.
   c. Provide layout drawings of panels and other custom assemblies containing switches, relays, terminal blocks, receptacles, etc., using reference numbers to identify physical locations of devices or label devices with reference numbers in a location visible while viewing cable terminations. On wiring diagrams, label all conductors within cables for insulation color or other identifier. Label connectors, barrier strips, switches, relay sockets, etc., for terminal number. If device does not provide terminal designations, provide key diagram for reference.

4. Receptacle Location Plan: Plan of area showing locations and designations of all receptacles.

5. Building Plan: Plan drawing of the building indicating the areas covered by the various zone volume controls.

6. Patch Panel Assignment Schedule: Mount a typed schedule of patch panel assignments behind acrylic at the equipment racks.

7. Control Setting Schedule: Fully document the settings of all non-user-adjustable controls. This includes power amplifier gain controls, equalizer settings, etc.

8. Complete Instruction and Maintenance Manual: Prepare in the form of an instructional manual for use by Owner's personnel. Provide one (1) draft copy and two (2) final copies unless otherwise specified.

9. Format:

    a. Size: 8-1/2" x 11", 20 lb. minimum weight white paper for typed pages, either manufacturer's printed data, or neatly typewritten.
    b. Drawings: Provide reinforced punched binder tab, bind in with text. Fold larger drawings to size of text pages. Clear plastic "binding tape" (not "Scotch" tape) applied to edge of sheet and then punched is acceptable.
    c. Single-sheet product literature and contractor-prepared pages: Provide reinforced punched binder tab. Clear plastic "binding tape" (not "Scotch" tape) applied to edge of page and then punched is acceptable.
    d. Provide indexed tabs and flyleaf for each separate product, or each piece of operating equipment. Include typed description of product, and major component parts of equipment.
    e. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS".
    f. Binders:
    g. Commercial quality three-ring binders with durable and cleanable plastic covers, 1" minimum, 2" maximum ring size.
    h. When multiple binders are used, collate the data into related consistent groupings.

10. Content of Manuals:

    a. Neatly typewritten table of contents for each volume, arranged in systematic order. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
    b. Contractor, name of responsible principal, address and telephone number.
    c. Certificate of Warranty for the system as a whole as well as copies of the manufacturer’s warranty for each equipment item.
    d. Service Contract. Include a preliminary schedule for the specified semi-annual site visits.
    e. Complete as-built diagrams for systems.
    f. Functional Diagram.
    g. Receptacle Location Plan.
    h. Patch Panel Assignment Schedule.
    i. Building Plan.
    j. Original copies, high-quality laser printer printouts of PDF files, or high-quality photocopies of manufacturers' installation, operation, and service manuals, including schematic diagrams for each equipment item.
    k. Shop drawings of all custom-fabricated items.
    l. Control Setting Schedule.
    m. Audiovisual Control System:

        1) Color printouts of touch screens control panel graphic layouts, as installed.

        2) Listing of system brand, models and all associated peripherals.

3) CD-ROM containing the master program for the system, the touch screen display program (including all macros), all programming, communication, or other project-specific software required for re-programming, and a limited license agreement for the use and modification of contractor-generated source code in connection with the maintenance and modification of the system for which it was written.

n. Software for Programmable Devices: Where a computer has been used in programming system components, provide CD-ROM and/or floppy disks containing the software, instructions for making interconnections to the programmed devices for the purpose of modifying the programming, and a limited license agreement for the use and modification of contractor-generated source code in connection with the maintenance and modification of the system for which it was written.

1.6 Job Conditions

A. Sequencing and Scheduling:

1. Coordinate work with adjacent work of other trades to facilitate construction and prevent conflicts.

2. Afford other trades reasonable opportunity for installation of work and for the storage of materials.

3. Staff the job to keep pace with the other Trades; otherwise, the Design Professional will require an increase in force or overtime work without additional expenses to the Owner.

4. Abide by the decision of the Design Professional in case of conflict or interference by other trades.

5. Refuse: Remove all refuse from the job site to the satisfaction of the Design Professional and Owner.

1.7 Warranty

A. Warrant all equipment to be free of faulty workmanship and defects, and from damage due to contamination by construction dust and debris for a minimum period of one year from date of final acceptance.

B. Warrant all repairs to "existing" equipment for a period of 90 days.

C. Emergency service: Within 24 hours of notification, restore the system to operation, replacing defective materials and repairing faulty workmanship. Make temporary repairs and provide loaner equipment at no charge if defective materials cannot be permanently replaced or repaired within this 24 hour time period.

D. Paint and exterior finishes, fuses, lamps, projection lamps, and video picture tubes excluded from above warranties except when damage or failure results from defective materials or workmanship covered by warranty.

E. The minimum warranty provisions specified above shall not diminish the terms of individual equipment manufacturers' warranties.

1.8 Service Contract

A. Provide a one-year service contract to commence after acceptance of installation without additional cost. Service to include two semi-annual visits to the site for routine adjustment and maintenance of all equipment. Provide a preliminary schedule for the semiannual visits.

B. Towards the end of each year's Service Contract, provide the owner with a proposal for continued service during the next year.

1.9 Training

A. The Owner may assign personnel to participate with the contractor during installation. Without delaying the work, familiarize the Owner's personnel with the installation, equipment, and maintenance.

B. During tests and adjustments, permit the Owner's personnel to observe. When feasible explain the significance of each test.

C. Provide sufficient training to personnel selected by the Owner on operation and basic maintenance of all systems and equipment. Explain operation of control systems, set-up and operation of individual pieces of equipment and functions of overall systems.

D. Separate from the bid response quotation, provide an hourly cost for additional training.

1.10 Inspection

A. Notify the Design Professional of any defects in work by other trades affecting installation.

Part 2 Products

2.1 Audio Products

A. Digital Audio Signal Processor:

1. CobraNet-based digital signal processor delivering uncompressed, multi-channel, low-latency digital audio via an Ethernet backbone. Flexible analog audio input and output via multi-slot card cage, I/O cards, and network based expansion modules.

2. Features:

   a. Up to 24 inputs/outputs, any combination by pairs.
   b. Acoustic Echo Cancellation (AEC) available as separate input module(s).
   c. Control via: PC/Laptop, remote control panels, and third-party control via RS-232.
   d. Primary and secondary CobraNet ports.
   e. Ethernet port.
   f. Software-based mixing, equalization, filters, crossovers, leveling, compander/limiter, ducking, automatic noise control, routing, delay, remote controls, metering, signal generation, and diagnostics.

3. Minimum Performance Requirements:

   a. Frequency Response (20-20,000 Hz +4dBu): ± 0.4 dB.

b. Total Harmonic Distortion + Noise (20-20,000 Hz +4dBu).
c. Line level: <0.006%.
d. Microphone level: <0.04%.
e. Equivalent Input Noise (20Hz~20kHz, 66dB gain, 150 ohm): -125dBu.
f. Dynamic Range (20Hz~20kHz, 0dB): > 107dB.
g. Sampling Rate: 48kHz.
h. A/D – D/A Converters: 24-bit.

4. Acceptable Products:

a. Biamp AudiaFLEX CM (Type 1) with 2-channel audio input cards IP-2 and 2-channel audio output cards OP-2e.
b. Biamp EXPI (Type 2).
c. Biamp EXPO (Type 3).
d. Approved Equal.

B. Network Audio Power Amplifier:

1. Modular, CobraNet-based power amplifier supporting digital signal processing, multiple failover configurations, and enhanced monitoring.

2. Features:

a. 3 RU rack mountable.
b. Primary and secondary CobraNet ports.
c. Ethernet port.
d. Up to 8 amplifier modules per frame with 100 to 600 Watts per module; maximum 2400 W per chassis.
e. 70V or 100V with direct drive capability or low-impedance (4 or 8Ω) operation.
f. LED Indication for: Signal present, Peak present, Clip present, Heat sink temperature fault, Amplifier failure, and Fan stuck-rotor.
g. Internal amplifier modules or entire device failover modes.
h. Software Monitoring Features: Peak present, Heatsink temperature (value, warning and fault), Short circuit on output, Amplifier failure, Impedance min/max threshold warning, Excessive clipping, Fan stuck-rotor.

3. Minimum Performance Requirements:

a. Inputs:

1) 20-bits.

2) Sample Rate: 48kHz.

3) CobraNet Latency: 5-1/3, 2-2/3, or 1-1/3ms (software configurable).

b. Outputs:

1) Supported Loads: 4Ω, 8Ω, 70V, or 100V.

2) Frequency Response: 20 Hz – 20 kHz (+/- 1dB).

3) Signal-to-Noise Ratio (unweighted, 22 Hz – 22 kHz) 100-600W:

a) 4 Ohm: >95dB

b) 8 Ohm: >95dB

c) 70V: >100dB

d) 100V: >101dB

4. Acceptable Products:

a. Biamp AudiaFusion with AM-600 power amplifier modules.
b. Approved Equal.

C. Message Server (ADD/ALT):

1. Network message server that supports message playback, event scheduling, and remote access.

2. Features:

a. Recorded message storage and playback.
b. Event scheduling.
c. Cobranet audio/control with dynamic use of available bundles over single Ethernet cable.

3. Acceptable Product:

a. Biamp Vocia Message Server (MS-1).
b. Approved Equal.

D. 4-channel Digital Messaging Output (ADD/ALT):

1. Network audio output expansion unit.

2. Features:

a. Converts digital to analog.
b. Support 4 analog outputs.
c. Cobranet audio/control with dynamic use of available bundles over single Ethernet cable.

3. Acceptable Product:

a. Biamp Vocia Output (VO-4).
b. Approved Equal.

E. Portable Messaging Station

1. Desktop networked paging station providing configurable operation for end-user ad hoc and preset messaging.

2. Features:

a. Push-to-Talk button with status indication.
b. Four user-configurable page codes.
c. Cobranet audio/control with dynamic use of available bundles over single Ethernet cable.
d. Supports Power-over-Ethernet (PoE).

3. Acceptable Products:

a. Biamp VociaDesk Station 4 (DS-4).
b. Approved Equal.

F. Rack Audio Monitor:

1. Two-channel analog audio monitor with dual high-resolution LED meters.

2. Features:

   a. 1 rack space enclosure.
   b. Simultaneous VU and Peak Hold display.
   c. Display Mode, Peak Hold, PPM Ballistics, Alternate Scales, and Phase Correlation adjustable via rear panel and internal DIP switches.
   d. Output limiter to protect speakers.
   e. 60 dB meter scale.

3. Minimum Performance Requirements:

   a. Frequency Response: 80 to 20000 Hz, ± 5 dB.
   b. Peak Output: 98dB SPL @ 2 ft.
   c. Hum and Noise: Better than -68 db below full output.

4. Acceptable Products:

   a. Wohler AMP1A-30.
   b. Approved Equal.

2.2 Network Hardware

A. 12-Port Layer 3+ Expandable Ethernet Switch:

1. 1 RU rack mountable Advanced Gigabit Layer 3+ Expandable Switch with 1x High Speed expansion bay and 12x combo ports and one fixed AC power supply.

2. Features:

   a. 1x60Gbps expansion bay.
   b. 12 x 10/100/1000BASE-T copper or SFP.
   c. Front panel has LEDs for each port to show activity.

3. Minimum Performance Requirements:

   a. Operates with 10/100/1000BASE-T Ethernet systems.
   b. Meets all performance standards for Layer3+ managed Ethernet switching.
   c. Connections are RJ-45 for 10/100/1000 connections
   d. Connections are 100TX, 100FX, 1000T, 1000SX, or 1000LX for SFP ports.
   e. Includes power supply.

4. Acceptable Products:

   a. Allied Telesis x900-12XT/S-60 with Telesis AT-SPSX or AT-SPSX10, as required.
   b. Approved Equal.

B. 24-Port Gigabit Ethernet Switch:

1. 1 RU rack mountable web managed switch supporting: port-based VLANS, IEEE 802.1p QoS, port trunking/link aggregation, port mirroring and IEEE 802.1x security.

2. Features:

   a. 24 x 10/100/1000BASE-T copper.
   b. 2 SFP combo ports.
   c. Front panel has LEDs for each port to show activity.

3. Minimum Performance Requirements:

   a. Operates with 10/100/1000BASE-T Ethernet systems.
   b. Connections are RJ-45 for 10/100/1000 connections.
   c. Connections are 100TX, 100FX, 1000T, 1000SX, or 1000LX for SFP ports.
   d. Includes power supply.

4. Acceptable Products:

   a. Allied Telesis AT-GS950/24-10 with Telesis AT-SPSX or AT-SPSX10, as required.
   b. Approved Equal.

C. 48-Port Gigabit Ethernet Switch:

1. 1 RU rack mountable web managed switch supporting: port-based VLANS, IEEE 802.1p QoS, port trunking/link aggregation, port mirroring and IEEE 802.1x security.

2. Features:

   a. 48 x 10/100/1000BASE-T copper.
   b. 4 SFP combo ports.
   c. Front panel has LEDs for each port to show activity.

3. Minimum Performance Requirements:

   a. Operates with 10/100/1000BASE-T Ethernet systems.
   b. Connections are RJ-45 for 10/100/1000 connections.
   c. Connections are 100TX, 100FX, 1000T, 1000SX, or 1000LX for SFP ports.
   d. Includes power supply.

4. Acceptable Products:

   a. Allied Telesis AT-GS950/48-10 with Telesis AT-SPSX or AT-SPSX10, as required.
   b. Approved Equal.

D. Digital Signage Media Player:

1. Network-based media player with HDMI output.

2. Acceptable Products:

   a. Cisco DMP 4310G-52-K9 with DMP- 4310G-SW52-K9 Full Node License, CON-SAS-4310GSW Digital Signage software, and CON-SNT-DMP431GD SMARTNET 8X5XNBD DMP 4310G HW.

3. Quantity as shown on drawings (one per Digital Signage Display) plus 5% “Attic Stock”.

2.3 Video Hardware

A. 15” Rackmount LCD Monitor:

1. High Definition 15" Rack Mount or Desktop LCD Monitor with all Digital/Analog HD/SD inputs.

2. Features:

   a. 1024 x 768 RGB Dots with 2.4 million pixels.
   b. 16.7 million colors.

c. 450:1 contrast ratio.
d. 4:3 and 16:9 screen aspect ratios for DTV applications in HD and SD formats.
e. Standard Multi-format inputs including: HD-SDI, SDI, Component Analog HD/SD, Composite Video PAL/NTSC, DVI-I, and SXGA.
f. Built-in Color Bar generator.

3. Acceptable Products:

a. Marshall V-R151DP-AFHD.
b. Approved Equal.

B. Dual 10” LCD Monitors:

1. TFT-MegaPixel SDI Multiformat Dual Screen 10.4-Inch Monitor Set.

2. Features:

a. Large 10.4-inch screens 800x600 Dots (1.44 million RGB pixels).
b. Match Color Conversion.
c. Adjustable Color Temperature.
d. 5 Year / 50,000 hour backlight life.
e. 10-bit Analog to Digital conversion.
f. High resolution scaling.
g. Wide viewing radius - 130° horizontal and vertical provides superior visibility.
h. 600 candelas per square meter (cd/m²) luminance produces enhanced image quality in varying light and viewing conditions.
i. 500:1 ratio of contrast between black and white luminance values.
j. 4:3 and 16:9 screen aspect ratios for DTV applications.
k. Direct access for all adjustments.

3. Acceptable Products:

a. Marshall V-R102DP-SD.
b. Approved Equal.

C. 46” LCD Displays (1st Floor Meeting Rooms- Digital Signage Type 1):

1. Widescreen High Definition Display with LED backlighting.

2. Features:

a. Native Resolution: 1920x1080.
b. Contrast Ration: 5,000,000:1.
c. Refresh Rate: 240Hz
d. Input Connectors: HDMI (x4), Component Video.

3. Acceptable Products:

a. Samsung UN46C7000 with Chief LTTU mount.
b. Approved Equal.

4. Quantity as shown on drawings plus four (4) displays w/ mounts “Attic Stock”.

D. 65” LED TV (Digital Signage – Type 6):

1. Widescreen High Definition LED TV.

2. Features:

   a. Native Resolution: 1920 x 1080.
   b. Contrast Ration: 5,000,000:1.
   c. Inputs: HDMI (x4), Analog D-sub, 3.5mm (PC Audio), Analog BNC, Composite, Component, EtherNet, RF, USB (x2).
   d. Outputs: 3.5mm (Stereo Audio).

3. Acceptable Products:

   a. Samsung UN65C6500 with a Chief XTMU mount.

2.4 Control Hardware

A. AV Control Processor:

1. 2-Series engine with Dual-bus architecture, 4GB Compact Flash memory card slot and Cresnet port - master/slave selectable.

2. Features:

   a. 10/100 Ethernet capable | SSL encryption.
   b. e-Control 2 and RoomView enabled.
   c. SNMP support | Built-in firewall, NAT and router.
   d. 6 Com ports, 8 IR/serial ports, 8 Versiport I/O ports, 8 Relay ports.
   e. 3 Y-Bus / 1 Z-Bus control card expansion slots.
   f. Internal power supply | 2-Space EIA rack-mountable.
   g. Front control panel with LCD display.

3. Acceptable Products:

   a. Crestron Pro2 with auxiliary power supplies and accessory components, as required.
   b. Approved Equal.

B. 8.4” Touch Panel:

1. 8.4" WiFi Wireless Touchpanel. Includes power supply/battery charger.

2. Acceptable Product:

   a. Crestron TPMC-8X.
   b. Approved Equal.

C. DSP / Audio Monitoring PC:

1. System specification TBD.

2. Acceptable Products:

   a. Dell Precision XXX with Dell E2010H 20” monitor.

D. Voltage Control Box: (ADD/ALT):

1. Four (4) Analog Inputs and four (4) Logic Inputs/outputs with five –wire control buss.

2. Acceptable Products:

a. Biamp Voltage Control Box

2.5 Audiovisual Pool Equipment

	Qty.	Manufacturer	Model	Description
B.	(6)	Extron	FOX HD-SDI MM	HD-SDI Fiber Transmitter/Receiver, Multimode
C.	(30)	Extron	FOXBOX Tx HDMI MM	HDMI Fiber Transmitter, Multimode
D.	(30)	Extron	FOXBOX Rx HDMI MM	HDMI Fiber Receiver, Multimode
E.	(20)	Extron	FOXBOX 4G Tx VGA MM	VGA Transmitter, Multimode
F.	(20)	Extron	FOXBOX 4G Rx VGA MM	VGA Fiber Receiver, Multimode
G.	(16)	Extron	FOX 2G Tx AV MM	AV Fiber Transmitter, Multimode
H.	(16)	Extron	FOX 2G Rx AV MM	AV Fiber Receiver, Multimode
I.	(4)	Extron	HDMI Pro/6	HDMI Cable, M-M, 6'
J.	(4)	Extron	HDMI Pro/12	HDMI Cable, M-M, 12'
K.	(4)	Extron	HDMI Pro/25	HDMI Cable, M-M, 25
L.	(50)	Custom		MM Fiber Cable, Duplex LC-LC, 6'
M.	(50)	Custom		MM Fiber Cable, Duplex LC-LC, 12'
N.	(50)	Custom		MM Fiber Cable, Duplex LC-LC, 25'
O.	(8)	Custom		MM Fiber Cable, Duplex LC-LC, 50'
P.	(2)	Rane	NM-1	Network Microphone Preamp

2.6 Equipment Racks, Panels, And Miscellaneous Accessories

A. Equipment Racks:

1. General:

a. Verify all rack sizes, types and finishes with design professional or project manager before ordering.
b. Verify and coordinate all blocking and clearance requirements before ordering.
c. Equipment rack for standard 19" wide panels. Minimum 16 gauge cold rolled steel construction with louvered sides. Mounting rails with tapped 10-32 threaded holes on EIA spacings. Welded construction.
d. Each rack furnished with permanently-mounted AC power 3 conductor grounded stripline rated for 15 amperes, with outlets on 6" centers, extending full height of rack, and with incandescent illumination attached for ease in servicing.

B. Free-Standing Equipment Racks:

1. Features:

a. Welded floor rack assembly, fixed side panels, solid front and solid, lockable rear door and adjustable mounting rails.
b. Overall depth 24" to 26.5”, height as indicated or required.
c. Lacing Bars: (1) vertical, (4) ‘L’ shaped straight, and (2) 4” offset.
d. Integrated fan top with three 4-1/2” fans.
e. One 20-Amp vertical outlet strip w/ twenty 5-20R outlets.
f. Provide caster bases where necessary for service access.

2. Acceptable Products:

a. Middle Atlantic Products ERK-4425AV with ERK-RR44 rear rack rails.
b. Approved Equal.

C. Gangable Equipment Racks:

1. Features:

a. Welded floor rack assembly, fixed side panels, lockable rear door, and adjustable mounting rails.
b. Overall depth 30” to 32”, height as indicated or required.
c. Lacing Bars: (1) vertical, (4) ‘L’ shaped straight, and (2) 4” offset.
d. Integrated fan top with one 10” fan.
e. One 20-Amp vertical outlet strip w/ twenty 5-20R outlets.
f. Provide caster bases where necessary for service access.

2. Acceptable Products:

a. Middle Atlantic Products MRK-4431AV (includes side panels) or MRK-4431AV-AB (without side panels); each with ERK-RR44 rear rack rails.
b. Approved Equal.

3. Credenza Rack.

4. Equipment rack with heavy-duty 14-guage steel top and bottom.

5. Features:

a. Static load capacity of 1000 lbs.
b. UL Listed capacity, 400 lbs.
c. Top accepts two fans.

6. Acceptable Products:

a. Middle Atlantic Products Slim 5.
b. Approved Equal.

D. Blank Panels:

1. 16-gauge flanged solid steel with black smooth ended for or textured enamel finish.

2. Acceptable Products:

a. Middle Atlantic SB series.

b. Atlas/Soundolier S19 series.

E. Equipment Rackmount:

1. Custom fabricated rackmount system for use with equipment, such as consumer VCRs, that are not provided with integrated rackmount ears. Increases the height of the device to the next larger rack unit size, eliminating unsightly gaps and providing complete trim. Includes custom faceplate with ears, and rackshelf with ventilated bottom.

2. Black brushed and anodized faceplate finish.

3. Acceptable Products:

a. Middle Atlantic Products RSH-4A with faceplate and shelf size as required.
b. Lowell RMK Series rackmount kit.
c. Approved equal.

F. Rack Drawers:

1. Pull-out steel storage drawers with latching pull handle designed to mount in standard 19" EIA equipment racks.

2. Features:

a. Inside dimensions 15-7/8" wide x 14" deep.
b. Fully enclosed top.
c. Full extension ball-bearing glides.
d. Laser knockout in rear for cables.
e. Keylock option.
f. Black brushed anodized finish.

3. Acceptable 2-Space Products:

a. Middle Atlantic D-2.
b. Raxxess SDR-2.
c. Lowell L-18 193.

4. Acceptable 3-Space Products:

a. Middle Atlantic D-3.
b. Raxxess SDR-3.
c. Lowell L-18 195.

G. Power Conditioner/Surge Protector:

1. One rack-space unit in a magnetic shielding steel enclosure. Operation from 120 volts AC with a 9-foot, grounded, 3-wire #12 line cord. Eight 15-Amp rear-panel outputs. Front-panel courtesy outlet and self-test circuit with visual indicator.

2. Features:

a. Load rating of 20 amps @ 120 volts, and provide advanced Impedance Tolerant™ EMI/RFI filtering.

b. Meets Federal Grade A, Class 1, Mode 1 Guidelines (CID A-A-55818) for powerline surge suppressors.
c. Three limiter circuits: a series surge reactor current limiter, a cascaded auto-tracking dual-polarity voltage limiter, and dual pulse inverters.
d. Onset clamping voltage shall be 172 volts, nominal, and the unit shall have an instant reacting snubber to protect against fast-rising surges generated within the installation location.
e. Unlimited Current Surge and Joule Limitation ratings (8 x 20 µs) and shall withstand at least 1000 occurrences of Surge Pulse Voltages up to 6000 volts.

3. Acceptable Products:

a. SurgeX SX1120-RT.
b. Approved Equal.

H. Rack Light/Power Module:

1. Rack-mounted unit with 2 slide-out light fixtures to illuminate the face of an equipment rack, high-voltage surge and transient suppresser with multi-stage RFI and EMI filter, and 8 switched outlets with total 15 amp capacity.

2. Acceptable Products:

a. Furman Sound PL-Plus C.
b. Approved equivalent.

I. Gooseneck Light Rack Panel:

1. Rack-mounted unit with recess containing two 12” miniature gooseneck LEDs with on/off switch and solid state power supply.

2. Acceptable Products:

a. Littlite RL-10D-LED.
b. Furman RL-1.
c. Approved Equal.

J. Rack Work Light:

1. Moveable work light with switch, interchangeable articulating arm with magnet and clamp for mounting, and a choice of two reflectors.

2. Acceptable Products:

a. Atlas Sound RWL2.
b. Equivalent.

2.7 General Equipment And Miscellaneous (All Rooms)

A. Programming:

1. Control System Programming:

a. Touch panel graphic design, page and button logic, and code programming to be provided by one of the following professional programming companies.

b. The control system programming subcontractor is required to work directly with the owner to provide sample panel layouts submittals coordinated with the general AV submittals for review by the AV consultant.
c. Menus to be arranged for user access via a PIN number, with a separate PIN and more comprehensive controls for technician access.
d. Control systems programming to include all network interface work required to complete and verify centralized AV control (Crestron RoomView).
e. For systems with touch panels, the control system programming subcontractor shall provide PDF simplified user operational manuals conforming to the final, accepted functional operation of the AV systems.
f. Acceptable Programming Subcontractors:

1) Control Concepts, Inc. (www.controlconcepts.net).

2) PepperDash (www.pepperdash.com).

3) ICD (www.icdsystems.com).

4) Approved equals.

B. 'MM3' Passive Microphone Poke-thru Inserts:

1. XLR microphone.

2. Features:

a. Neutrik 3-pin female connector to solder cup.
b. Compatible with Wiremold Evolution Series 68MAAP poke-thru device.
c. Mounting Plate to be black.

3. Acceptable Product:

a. Extron IN9365D P/N 70-296-11.

C. 'MM3' Blank Poke-thru Inserts:

1. Single or double space blank inserts.

2. Features:

a. Compatible with Wiremold Evolution Series 68MAAP poke-thru device.
b. Mounting Plate to be black.

3. Acceptable Product:

a. Extron IN9350 P/N 70-315-11.
b. Extron IN9367D P/N 70-315-12.

D. Press Feed Pedestal Assembly (ADD/ALT):

1. Bolt-down Steel Pedestal with NEMA 4 enclosure and custom output panel.

2. Features:

a. 23" x 4" x 4" bolt-down column.
b. 12" x 12" x 6" NEMA4 Enclosure with sub-plate and optional / 3rd party locking handle.
c. Custom AV plate with stand-offs, as needed.

3. Acceptable Products:

   a. Hoffman AP23B44.
   b. Hammond Manufacturing EN4SD12246LG.
   c. Hammond Manufacturing EP1212.

E. Cabling and Miscellaneous Products:

1. Cables (Non-Plenum Applications):

   a. Microphone and Line Level Lines:

      1) Twisted pairs of color-coded stranded conductors with overall foil shield, stranded tinned copper drain wire, and jacket.

         a) AWG #22, maximum diameter .175 inches.

            Acceptable Products:

            Belden 8761.

            West Penn 291.

            Alpha 2401.

   b. Loudspeaker Lines:

      1) Twisted color-coded stranded and paired conductors with overall jacket. Gauge as shown on drawings.

      2) NEC FPLP Listed for fire alarm use.

         a) AWG #14, nominal diameter .332 inches.

            Acceptable Products:

            Belden 5100UL.

            Or equal.

   c. Precision Video Lines (use for all discreet video connections and in-rack wiring):

      1) Low-noise coaxial cable with polyethylene dielectric, foil-plus-copper-braid shield, and overall PVC jacket.

      2) Nominal Attenuation: .87 dB/100 ft. at 10 MHz.

      3) Nominal Impedance: 75 ohms.

      4) #20 AWG solid bare copper center conductor, nominal cable O.D., .235 inches.

      5) Acceptable Products:

         a) Belden 1505A.

         b) West Penn 819.

         c) CommScope 5565.

         d) Equivalent.

   d. Precision Video Lines (use for all RGBHV combination runs.)

      1) Low-noise coaxial cable with polyethylene dielectric, foil-plus-copper-braid shield, and overall jacket containing all 5 individually contained coaxial cables.

2) Nominal Impedance: 75 ohms.

3) Five (5) #20 AWG solid bare copper center conductors, nominal cable O.D., .595" inches.

4) Acceptable Products:

a) West Penn WP 258195.

b) Equivalent.

e. Remote Control Lines:

1) Color-coded stranded copper conductors with overall jacket.

2) AWG #18, with number of conductors as specified.

3) Provide plenum-rated equivalent where required.

4) Acceptable Products:

a) Alpha 5062 to 5070.

b) Equivalent.

f. Category Six Data Cable:

1) Four-pair unshielded twisted pair cable, AWG#23, nominal diameter 0.365"x0.165". Exceeds requirements for Category Five applications.

2) Minimum Performance Requirements:

a) Mutual Capacitance: 15 pF/ft at 1 KHz.

b) Impedance: 100 ohms ±12%, 0-350 MHz.

c) Return Loss: 20 dB, 0-200 MHz.; 17 dB, 0-350 MHz.

d) Delay Skew: 25 ns/100m max.

e) Capacitance Unbalance: 49.2 pF/100m max.

3) Acceptable Products:

a) Belden MediaTwist 1872A.

b) Approved equal.

g. Cable Markers:

1) High-grade PVC clip-on or permanent-type cable markers with permanent markings, or printed vinyl tape protected by clear shrink tubing or adhesive wrap.

2) Acceptable Products:

a) Electrovert Type C or Z.

b) Brady B-702 with Alpha FIT-221 series clear tubing.

c) Thomas & Betts EZCODER.

2. Portable Cables:

a. Microphone Cables:

1) 25': Whirlwind MKQ25 black.

2) 50': Whirlwind MKQ50 black.

b. Loudspeaker Cables:

1) 25': Rapco 12 AWG commercial series with Neutrik NL4 and ¼" phone connectors.

c. Production Communication Cables:

1) 25': Whirlwind MKQ25 blue.

2) 50': Whirlwind MKQ50 blue.

3. Microphone and Line-Level Line Terminal Blocks:

a. Insulation displacement "punch" block.

b. Contact Construction: Insulation displacement phosphor bronze contact, with plastic insulator, for AWG #22, #24, and #26 solid or stranded wire, allowing 100 insertions/ withdrawals, and accepting four wires total for each connection point.

c. Acceptable Products:

1) ADC Products UP3 with UP-W or UP-R mounts as required with one Q-814-804 wire insertion tool.

2) Siemon Multiflex block with one 714 insertion tool with cutting blade.

4. Connectors:

a. Microphone and Line Connectors (Panel Mount):

1) Unbalanced Cable-End: Two-conductor RCA plug or jack connector with steel shell and internal cable clamp. Provide with minimum 2" of rubberized shrink-wrap strain relief at each connector.

a) Acceptable Products:

Switchcraft 3502 or 3503 as required.

Equivalent.

2) Balanced Input Receptacles: female gender "XLR"-type receptacles.

a) Acceptable Products:

Switchcraft C3F or D3F.

Equivalent.

3) Balanced Output Receptacles: Male gender "XLR"-type receptacles.

a) Acceptable Products:

Switchcraft C3M or D3M.

Equivalent.

4) Dual Format Line Input Receptacles: Balanced input receptacle accepting both male gender "XLR"-type connectors and 1/4" TRS phone plugs.

a) Acceptable Products:

Neutrik NCJ6FK-V.

Equivalent.

5) Unbalanced Input and Output Receptacles: Two-conductor 1/4" phone jacks with type J-4 single-closed circuit schematic, molded plastic enclosure, and insulating molded nylon bushing.

a) Acceptable Products:

Switchcraft N112A or NL112A as required.

Equivalent.

6) Locking 1/4" Receptacles: Two- or three-conductor 1/4" phone jacks with locking tab to prevent accidental removal of plug.

a) Acceptable Products:

Switchcraft E111L (2-cond.) or E112BL (3-cond.) as required.

Neutrik NJ3FP6C.

Equivalent.

7) Unbalanced Input and Output Receptacles: Female gender phono jacks (RCA jack) with closed circuit switching and non-grounding mount.

a) Acceptable Products:

Switchcraft 3512.

Equivalent.

8) 1/8” Mini Stereo Phone Jack: Female gender, 3-conductor, open-circuit, enclosed, panel-mount, 1/8” phone jack.

a) Acceptable Products:

RS 274-249.

Equivalent.

b. Microphone and Line Connectors (Cable Mount):

1) Balanced Input Connectors: female gender “XLR”-type connectors.

a) Acceptable Products:

Switchcraft A3F.

Neutrik NC3FX.

2) Balanced Output Connectors: male gender “XLR” type connectors.

a) Acceptable Products:

Switchcraft A3M.

Neutrik NC3MX.

3) 1/4” Phone Plug: Two- or three-conductor 1/4” phone jacks.

a) Acceptable Products:

Switchcraft 184 (2-cond.) or190 (3-cond.) as required.

Neutrik NP-2C (2-cond.) or NP-3C (3-cond) as required.

c. Video Receptacles:

1) Insulated, feed-through BNC panel jack with beryllium copper outer conductor spring for use with RG-59/U-type cables.

2) Cable termination: BNC.

3) Acceptable Products:

a) Trompeter UBJ28.

b) Kings KC-99-54.

c) ITT Pomona 3846.

d) Canare BCJ-JR with IU-7/16 panel isolation bushing.

d. Recessed Video Receptacles:

1) Insulated, feed-through BNC panel jack in recessed housing to resist damage to connector.

2) Impedance: 75 ohms.

3) Cable Termination: BNC

4) Acceptable Products:

a) Canare BCJ-JRU.

e. BNC Video Cable Connectors:

1) BNC type for terminating video cable in conduit or video extension cables. Crimp connector with beryllium copper outer conductor spring and captive center pin, exceeding MIL-C-390l2,A.

2) For Belden 8281 type cable.

a) Acceptable Products:

Kings KC-59-299 (use KTH-1000 crimp tool, KTH-2012 die, and KTJ-43 and KTD-30 trim jigs).

Belden BNC0081 (use 9CRT012 crimp die).

Trompeter UPL-220-016.

3) For Belden 8281A type cable.

a) Acceptable Products:

Kings 755-48-9 (use KTH-1000 tool, KTH-2178 die, and KTJ-43 and KTD-406 trim jigs).

Belden BNC0082 (use 9CRT078 crimp die).

4) For Belden 8279 type cable.

a) Acceptable Products:

Kings KC-59-397 (use KTH-6000 crimp tool, KTH-6029 die, and KTJ-134 and KTD-26 trim jigs).

Belden BNC0079 (use 9CRT026 crimp die).

Trompeter UPL-220-019.

5) For RG 59/U type cable.

a) Acceptable Products:

Kings KC-59-294.

Belden BNC0041 (use 9CRT0022 crimp die).

Trompeter UPL-220-013.

Canare BCP-C4 with one TC-0 crimp tool and TC-D-4C die.

6) For Belden 1505A type cable.

a) Acceptable Products:

Kings 2025-51-9.

Trompeter UPL-220-014.

7) For Belden 1506A type cable.

a) Acceptable Products:

Kings 2025-53-9.

Trompeter UPL-220-023.

f. RCA type connector for RG-59/U Type Video Cables:

1) 75 Ohm true impedance matched RCA type connector.

2) Crimps to any RG-59 type cable.

3) VSWR 1.1 or less to 200 MHz.

4) Fully captive gold plated center pin.

5) Nickel plated brass body with Beryllium copper outer contacts.

6) Acceptable Products:

a) Canare RP-C4 series with TC-1 Crimp tool and TCD-series crimp die.

g. Normalled Video Receptacle:

1) BNC panel jack with built-in switch activated by insertion of BNC connector.

2) Impedance: 50 ohms.

3) Acceptable Products:

a) Black Box Corp. NP-WP360 (jacks remounted on wall plate).

h. S-Video To Y/C Adapter:

1) Adapts din-type S-Video output cable to separate Y/C coaxial video cables.

2) Acceptable Products:

a) Panasonic ET-100YC S-Video adapter.

i. Heavy-Duty RJ-45 Connectors:

1) Standard CAT 5e RJ-45 connectors housed in XLR-type connector shell for physical protection.

2) Acceptable Products:

a) Neutrik NE8FAV-Y110 panel connector, NE8MC cable connector, and BSE and ACRF color-coded accessories.

2.8 Patch Panels, Terminal Blocks, And Connectors

A. Audio Patching Equipment:

1. Audio Patch Panel:

a. 2RU assembly with 48 jacks in two rows of 24 each in a black plastic front panel, and insulation-displacement quick-connect panel contacts and insulators mounted to rear of metal chassis. Continuous horizontal designation strip for each row of jacks, and vertical designation strips for left and right sides.

b. All jack openings provided with jacks. Each jack factory-wired with 2-conductor shielded cable to each set of connectors on the rear terminal block.

c. Jack Circuit Type: 3-conductor, 1/4" diameter double closed circuit long-frame telephone jacks wired to allow normaling to be selected at the terminal block.

d. Jack Construction: Cadmium-plated steel frames with nickel silver springs and gold-plated contacts.

e. Terminal Block Circuitry: Separate tip, ring, sleeve, ring normal, tip normal, and sleeve normal contacts for each jack.

f. Terminal Block Contact Construction: Split cylinder insulation-displacement phosphor bronze contact with plastic insulator for AWG #22, #24, and #26 solid or stranded wire, allowing 100 insertions/withdrawals, and accepting two wires on each side (four wires total for each cylinder); or split terminal to accept up to four AWG #20 wires.

g. Acceptable Products:

1) ADC Products PPA3-14 MKIVSN with vertical designation strips and one wire insertion tool.

2) Approved equal.

2. Audio Patch Cords:

a. Two-conductor plus shield, with braided nylon jacket and single plug at each end.

b. Plugs: Nickel-plated 3-conductor, 1/4" diameter, ring-tip-sleeve plugs with machined brass parts and plastic handles.

c. Acceptable Products – 2 Foot:

1) ADC Products BK2.

2) Neutrik NKTB05-BLK.

3) Approved equal.

B. Video Patching Equipment:

1. Video Patch Panel:

   a. 2RU jack panel of insulated construction with two rows of 24 jack positions each. Continuous designation strips at top and bottom of each panel, clearly labeled according to function or to assignment schedule if shown.
   b. Normalled through jacks vertically adjacent and looping jacks horizontally adjacent.
   c. Unused jack positions closed with plastic plugs.
   d. Jack Circuits: 2 conductor, WECO compatible, 75 ohm coaxial jacks with open, self-terminating, normalled through non-terminating, and normalled through self-terminating circuits as shown.
   e. Jack Sleeves and Frames: Brass.
   f. Center Conductor: Beryllium copper.
   g. Conductor Surfaces: Gold plated.
   h. Cable Connector: BNC.
   i. Acceptable Products:

      1) ADC PPI-2224RS with SJ 2000G, SJ 2000G75, and CJ-1011G jacks as shown.

      2) Canare 242U-DVJW-C with DVJ-W and DVJ-S jacks as shown.

2. Video Patch Cords:

   a. 75-ohm coaxial patch cords with RG59/U cable and WECO compatible plugs at each end.
   b. Acceptable Products:

      1) ADC BK2V.

      2) Canare VPC002FB.

3. Looping Plug:

   a. Acceptable Products:

      1) Trompeter LPW-75.

      2) ADC CP1063G or CP1063N.

4. Looping Plug with Test Point:

   a. Acceptable Products:

      1) Trompeter LPWTP-75.

      2) ADC CP1043G or CP1043N.

C. Patch Cord Holder:

1. Cable holder accepting max. 0.32" diameter cables and designed to mount to vertical surface.

2. Acceptable Products:

   a. ADC ProPatch PPH Series.
   b. Audio Accessories "Maxi" PCH Series (audio) and VPCH series (video).
   c. Trompeter CH50.

D. Patch Bay Labels:

1. Permanent patch bay labeling shall not be supplied until the owner has operated the facility for 30 days. Temporary labeling must be typewritten or computer printed on full length label strips.

2. After 30 days, the contractor shall ascertain any changes to the patch bay layout.

3. Install permanent label strips.

4. Permanent strips shall be washable shrink resistant and fade resistant plastic. Letters shall be black on white and/or white on black. Use both types to break up patch labeling into functional groups.

5. Lettering shall be photo-composited.

6. Label strips shall be protected by clear plastic or acetate protector strips.

7. Colored transfer color such as pantone may be applied over areas with black lettering on white background to further differentiate functional groups.

8. Acceptable Products:

   a. Patch Bay Designation Company, Division of Glendale Rubber Stamp Co. Patch Prints.
   b. Approved equal.

E. Microphone and Line-Level Line Terminal Blocks:

1. Insulation displacement "punch" block.

2. Contact Construction: Insulation displacement phosphor bronze contact, with plastic insulator, for AWG #22, #24, and #26 solid or stranded wire, allowing 100 insertions/ withdrawals, and accepting four wires total for each connection point.

3. Acceptable Products:

   a. ADC Products UP3 with UP-W or UP-R mounts as required with one Q-814-804 wire insertion tool.
   b. Siemon Multiflex block with one 714 insertion tool with cutting blade.

F. Connectors:

1. Microphone and Line Connectors (Panel Mount):

   a. Unbalanced Cable-End: Two-conductor RCA plug or jack connector with steel shell and internal cable clamp. Provide with minimum 2" of rubberized shrink-wrap strain relief at each connector.

      1) Acceptable Products:

         a) Switchcraft 3502 or 3503 as required.

         b) Equivalent.

b. Balanced Input Receptacles: female gender "XLR"-type receptacles.

1) Acceptable Products:

a) Switchcraft C3F or D3F.

b) Equivalent.

c. Balanced Output Receptacles: Male gender "XLR"-type receptacles.

1) Acceptable Products:

a) Switchcraft C3M or D3M.

b) Equivalent.

d. Dual Format Line Input Receptacles: Balanced input receptacle accepting both male gender "XLR"-type connectors and 1/4" TRS phone plugs.

1) Acceptable Products:

a) Neutrik NCJ6FK-V.

b) Equivalent.

e. Unbalanced Input and Output Receptacles: Two-conductor 1/4" phone jacks with type J-4 single-closed circuit schematic, molded plastic enclosure, and insulating molded nylon bushing.

1) Acceptable Products:

a) Switchcraft N112A or NL112A as required.

b) Equivalent.

f. Locking 1/4" Receptacles: Two- or three-conductor 1/4" phone jacks with locking tab to prevent accidental removal of plug.

1) Acceptable Products:

a) Switchcraft E111L (2-cond.) or E112BL (3-cond.) as required.

b) Neutrik NJ3FP6C.

c) Equivalent.

g. Unbalanced Input and Output Receptacles: Female gender phono jacks (RCA jack) with closed circuit switching and non-grounding mount.

1) Acceptable Products:

a) Switchcraft 3512.

b) Equivalent.

h. 1/8” Mini Stereo Phone Jack: Female gender, 3-conductor, open-circuit, enclosed, panel-mount, 1/8” phone jack.

1) Acceptable Products:

a) RS 274-249.

b) Equivalent.

i. Multipin Receptacles:

1) Multipin connectors compatible with microphone snakes supplied. Gender and channel capacity as shown on drawings and/or equipment schedule.

2) Acceptable Products:

a) Whirlwind or Wireworks as required.

b) Approved equal.

2. Microphone and Line Connectors (Cable Mount):

a. Balanced Input Connectors: female gender “XLR”-type connectors.

1) Acceptable Products:

a) Switchcraft A3F.

b) Neutrik NC3FX.

b. Balanced Output Connectors: male gender “XLR” type connectors.

1) Acceptable Products:

a) Switchcraft A3M.

b) Neutrik NC3MX.

c. 1/4” Phone Plug: Two- or three-conductor 1/4” phone jacks.

1) Acceptable Products:

a) Switchcraft 184 (2-cond.) or190 (3-cond.) as required.

b) Neutrik NP-2C (2-cond.) or NP-3C (3-cond) as required.

3. Loudspeaker Connectors and Receptacles (4 conductor):

a. General: Connector system specifically designed for high power loudspeaker signal distribution, with twist type locking device. Contacts nickel-gold alloy, 250 VAC, 30 amps continuous per contact.

b. Cable Connectors: Four contacts, wired separately per manufacturer's recommendation for bi-amplified applications, or with pins 1+ and 1- (pins 2+ and 2- not used) for single channel applications. Cable strain-relieved with chuck type retainer for cable diameters 5-15mm (.2-.6 inch). Cable conductors attached with screws (not soldered) to facilitate field repair. Cable conductor size AWG #10 maximum. Each pair for extension cables supplied complete with one in-line coupler to permit cable linking.

1) Acceptable Product:

a) Neutrik "SPEAKON" Model NL4FC with NL4MM coupler.

b) Wall or Panel Receptacles: Airtight connector compatible with above cable connectors, size 26mm W x 3/mm H. Contacts wired with Faston connectors (not soldered).

2) Acceptable Product:

a) Neutrik "SPEAKON" Model NL4MP with Faston connectors.

4. Video Receptacles:

a. Insulated, feed-through BNC panel jack with beryllium copper outer conductor spring for use with RG-59/U-type cables.

b. Cable termination: BNC.

c. Acceptable Products:

1) Trompeter UBJ28.

2) Kings KC-99-54.

3) ITT Pomona 3846.

4) Canare BCJ-JR with IU-7/16 panel isolation bushing.

5. Recessed Video Receptacles:

a. Insulated, feed-through BNC panel jack in recessed housing to resist damage to connector.
b. Impedance: 75 ohms.
c. Cable Termination: BNC
d. Acceptable Products:

1) Canare BCJ-JRU.

6. BNC Video Cable Connectors:

a. BNC type for terminating video cable in conduit or video extension cables. Crimp connector with beryllium copper outer conductor spring and captive center pin, exceeding MIL-C-390l2,A.
b. For Belden 8281 type cable.

1) Acceptable Products:

a) Kings KC-59-299 (use KTH-1000 crimp tool, KTH-2012 die, and KTJ-43 and KTD-30 trim jigs).

b) Belden BNC0081 (use 9CRT012 crimp die).

c) Trompeter UPL-220-016.

c. For Belden 8281A type cable.

1) Acceptable Products:

a) Kings 755-48-9 (use KTH-1000 tool, KTH-2178 die, and KTJ-43 and KTD-406 trim jigs).

b) Belden BNC0082 (use 9CRT078 crimp die).

d. For Belden 8279 type cable.

1) Acceptable Products:

a) Kings KC-59-397 (use KTH-6000 crimp tool, KTH-6029 die, and KTJ-134 and KTD-26 trim jigs).

b) Belden BNC0079 (use 9CRT026 crimp die).

c) Trompeter UPL-220-019.

e. For RG 59/U type cable.

1) Acceptable Products:

a) Kings KC-59-294.

b) Belden BNC0041 (use 9CRT0022 crimp die).

c) Trompeter UPL-220-013.

d) Canare BCP-C4 with one TC-0 crimp tool and TC-D-4C die.

f. For Belden 1505A type cable.

1) Acceptable Products:

a) Kings 2025-51-9.

b) Trompeter UPL-220-014.

g. For Belden 1506A type cable.

1) Acceptable Products:

a) Kings 2025-53-9.

b) Trompeter UPL-220-023.

7. RCA type connector for RG-59/U Type Video Cables:

a. 75 Ohm true impedance matched RCA type connector.
b. Crimps to any RG-59 type cable.
c. VSWR 1.1 or less to 200 MHz.
d. Fully captive gold plated center pin.
e. Nickel plated brass body with Beryllium copper outer contacts.
f. Acceptable Products:

1) Canare RP-C4 series with TC-1 Crimp tool and TCD-series crimp die.

8. RJ-45 type connector for control:

a. Panel mount RJ-45 connector in color selected by Design Professional.
b. Meets or exceeds CAT5E specifications.
c. Acceptable Products:

1) Hubbell HD5EB6.

2) Panduit Powersum Series.

3) Leviton 56108 Series.

9. RF Plug connector:

a. 75 Ohm RJ-6 compression type connector.
b. Crimps to specified RG-6 cable.
c. Acceptable Products:

1) Gilbert UltraSeal Series.

2) Thomas & Betts (LRC) Snap-N-Seal Series.

3) Blonder Tongue equivalent.

Part 3 Execution

3.1 General

A. All types of equipment installed by competent workers at locations shown on the drawings in strict accordance with approved shop drawings and manufacturer's instructions.

B. All delivered equipment, except portable equipment, firmly fastened or held in place. “Delivered equipment” includes loudspeakers, enclosures, amplifiers, cables, etc. Apply a minimum safety factor of four (4) times the load for all equipment fastenings and supports.

C. Take necessary precautions to prevent and guard against electro-magnetic and electro-static hum and to install the equipment to provide safety for the operator.

D. Protect all equipment, including patch panels, connectors, receptacles, racks, consoles, and video projectors, from construction dust and debris until final acceptance of the system.

3.2 Integration/Installation

A. Conformance to Existing Standards:

1. Wherever possible provide equipment, finishes, and interfaces similar in nature to systems already in use by the Owner. Provide uniform functionality and operation to enhance ease of use and minimize instruction. Provide uniform finish and equipment to enhance the aesthetic unity of systems facility wide, and to improve end-user familiarity with equipment.

B. Labels:

1. Dry transfer, “Dymo”, or other types of adhesive labels are not acceptable.

2. Except where otherwise specified, label as shown on drawings each item of rack-mounted equipment and all switches, controls, and receptacles.

3. Switch and Control Panels: Constructed of engraved and filled anodized aluminum plates. Minimum 1/8" plate thickness. Dry transfer or other types of adhesive labels not acceptable.

4. Rack-Mounted Equipment: Labels constructed of engraved and filled plastic laminate engraving stock. Designate function and input and output line(s) or loudspeaker(s) served by labeled equipment. Key all designations to system functional and patch panel diagrams. Where possible, mount labels on blank panel directly above corresponding component. For modular equipment, provide label on inside of mainframe door identifying type of module for each slot (unless there is only one type) and gain setting as established at final checkout.

5. Identification Panel: See drawings for layout and nomenclature. AV Contractor is responsible for completing all bracketed items with the appropriate project-specific information.

6. Branding and Recognition: Identification of the contractor, or use of contractor logos or similar “trademarks” or “signatures” (including but not limited to touchpanel graphics and color schemes, silk-screened or engraved corporate logos, copyrighted fonts, and/or custom emblazoned panels) is strictly forbidden except where explicitly indicated within the bid documents. Any unauthorized use of these marks will be rejected.

7. Receptacles: Engrave and fill receptacle label directly on mounting plate as indicated on drawings.

8. Identify all wires and cables at every termination and connection point with the specified cable markers. Use a numbering scheme that identifies all cables terminating at patch panel jacks with the patch bay row and jack designation; use A, B, and C suffixes to distinguish multiple cables terminating at the same jack.

9. Identify switches, relays, terminal blocks, etc., with reference numbers keyed to the as-built wiring diagrams.

10. Room numbers appear on the contract documents for reference only. All labels shall reflect the Owner's final room designations.

11. All labels and legends shall be as approved on shop drawings.

C. Microphone Equipment:

1. General:

a. Excluding wireless microphones, each portable microphone provided with case, stand adapter and min. 15-ft. cable with attached XLR-type connector.

2. Wireless Microphone System:

a. General:

1) Verify that selected operating frequencies are free of interference from external sources.

2) Orient antennas as recommended by manufacturer. Locate in positions shown on drawings.

3) Terminate all unused RF inputs and outputs.

4) Except for transmitter equipment, all equipment including preamps and active combiners requiring DC power provided with power supplies or powered by receivers (battery operation is not acceptable).

5) Do not mount antennas or attached preamplifiers directly to any metal structure. Mount at least 3 ft. from any large metal object.

6) Verify antennas receive maximum reception of signals. If little or no reception is available, relocate antennas to new location where adequate reception can be achieved. Coordinate new location with Design Professional and Consultant prior to relocating.

b. Antenna Cables: Use specified low-loss 6/U (75 ohm) or 8/U (50 ohm) cable, impedance as required.

D. Amplifiers and Signal Processors:

1. Gain Control Security:

a. Amplifiers and Signal Processing Equipment: Power amplifiers and signal processing equipment with front panel controls or power switches which are to be permanently adjusted (not normally adjusted by the operator), such as equalizers, distribution amplifiers, limiters, and audio delays, shall be furnished with security panels or subpanel mounted behind blank panels.

2. Overall Gain:

   a. Program control system and DSP to provide that the overall volume level will remain constant when switching between all audio sources.

E. Loudspeaker Equipment:

1. Coordinate installation of ceiling mounted loudspeakers with Design Professional and with other trades as required.

2. Provide loudspeaker mounting as shown or required on or by AV system drawings and this specification. Provide mounting details to Design Professional and Consultant prior to fabrication or installation. Mounting hardware to be ATM flyware or approved equal.

3. Provide and install safety cables to individually secure all components and mountings from independent suspension points.

4. Provide all rigging, structure and framework as required to properly support the loudspeakers. Provide shop drawings of proposed structure to Design Professional and Consultant for review prior to fabrication or installation. Obtain the stamp of a structural engineer registered in the same state as the construction site on shop drawings which depict loudspeaker cluster structure, rigging, framework and support system(s).

5. Provide all loudspeakers and associated loudspeaker hardware/equipment with finishes according to the Design Professional.

6. Verify locations, angles, and elevations for each speaker. Final locations may deviate from consultant's drawings to accommodate building circumstances not within control of Consultant or Contractor. Overall, aesthetics and the symmetry of the acoustical image should be preserved.

7. Verify all loudspeakers are delayed and equalized properly.

F. Ceiling Loudspeakers:

1. Locate loudspeakers as indicated on AV drawings.

2. Refer all questions and/or decisions regarding installation and finish methods to the Design Professional and Consultant.

G. Digital Processor Programming:

1. Program digital signal processors so that all amplifiers receive the appropriate signal, delay, equalizations, etc.

2. Provide presets for control by AV control system.

3. Provide functionality as described elsewhere in this specification and on the AV drawings.

   a. As indicated elsewhere in the contract documents or as required.

b. Provide source code of processors configuration to Consultant for approval prior to programming system as directed under Section 1.5 – Submittals.

H. LCD Monitors:

1. Verifications:

a. Verify locations and elevations shown on drawings.

2. Submittals:

a. Provide detailed drawings of hardware.

3. Mounting:

a. DO NOT DISCARD ANY MONITOR OR PROJECTOR SHIPPING OR PACKING MATERIALS. SHIPPING CONTAINERS AND MATERIALS SHOULD BE TURNED OVER TO OWNER.
b. Install display mount at location and elevation indicated on approved shop drawings.
c. Display mounts must meet all applicable safety and code requirements for wall mounted equipment.
d. Fixed display mounts must be rigid and completely free of sway or rotation deviation.
e. Wherever possible, minimize hardware and cables visible from audience seating and presenter area view points.
f. Paint exposed mounting hardware to match room interior or as instructed by Design Professional.
g. Where others provide structural mounts or millwork openings, verify correct positioning and dimensions before mounting projector. Provide written notification to the Owner or Design Professional of any discrepancies in mount positioning or stability deficiencies before projector installation.
h. Provide all necessary display brackets, fittings, miscellaneous hardware and wireways.

4. Alignment, Focus, and Electronic Testing:

a. Adjust focus for distortion free text.
b. Adjust gain and equalization for cable loses and to meet production requirements.
c. For computer sources use VTG-300 or other approved test pattern generator.
d. Verify color uniformity.

I. Ethernet Connectivity:

1. Coordinate Ethernet connectivity and IP addressing of AV equipment with Electrical Contractor and the Communications/Technology management of the facility.

2. Co-ordinate with end-user, and Communications/Technology management of the facility, on POP-3 email notification of system service issues where desired and/or where possible.

J. Control Equipment:

1. Programming Rights:

a. Provide all Control System Programming to the end users upon completion and approval of system installation and integration.

b. Freely share programming graphics and blocks with the owner to ensure consistent facility-wide standards and system support. Project specific programming and graphics are not the exclusive property of the AV system contractor or programmer.

2. Audiovisual Control System:

a. Carefully coordinate the dimensions and mounting conditions of all items with manufacturer and with Owner or Design Professional.
b. Provide all required cable, relays, and miscellaneous hardware to interface the audiovisual control system with projection screens and other equipment indicated.
c. Install all components so as to use the maximum amount of any tally signals provided by the controlled equipment.
d. Provide sketches for all panels with shop submittals and prior to programming.
e. Verify font size and type with button sizes and styles.
f. Enhancements and/or augmentation of control parameters are acceptable with approval.
g. Program control system to recover from any loss of power without operator or contractor service.
h. Provide all hardware, software and programming required for a complete and fully functional system as intended and identified in this specification.

3. Audiovisual Control System Programming:

a. Refer to system drawings for logic, layout and other programming routines.
b. Program system as indicated below and on system drawings so that all devices are controlled in a logical manner, and to take full benefit of the capabilities of the Control System.
c. Notify the consultant of any software/hardware conflicts and provide written documentation from the control system manufacturer of any software or hardware incompatibilities or interface restrictions.
d. Defer to the Consultant's judgment for all alternative user-interface solutions.
e. Button text to be provided as shown on drawings.
f. LED indicators to indicate current function status.

4. Ethernet/IP/Local Area Network Accessibility and Control:

a. Coordinate Ethernet connectivity and IP addressing of control devices with Electrical Contractor and the Communications/Technology management of the facility.
b. Provide end-user with remote control and management interfacing via Local Area Network access from a PC to any IP addressed control devices.
c. Co-ordinate with end-user, and Communications/Technology management of the facility, on POP-3 email notification of system service issues where desired and/or where possible.

5. Local Area Network Management Programming:

a. Room by room AV system control:

1) Use included Ethernet connectivity hardware of control systems.

2) For “Crestron” format systems: Provide additional “Enterprise” software for implementation of large-scale systems only where the quantity of IP controllable hardware exceeds 25 facility-wide AND no previous large-scale management software exists. Coordinate with consultant and Communications/Technology management of the facility to verify large-scale systems management needs. New control programming should be integrated with any pre-existing and compatible facility-wide IP control management software.

3) For “AMX” format systems: Provide site/system license for each additional (discreet) IP controllable system. Coordinate with consultant and Communications/Technology management of the facility to verify large-scale systems management parameters. New control programming should be integrated with any pre-existing and compatible facility-wide IP control management software.

4) Remote site portal replicates the appearance and function of installed button control panels and touch-screen hardware where applicable.

5) Can be launched locally from designated AV technician computer as stand-alone “.exe” Windows-based executable file.

b. Remote System Status Monitoring and Management Programming:

1) Use included software and Ethernet connectivity hardware of control systems.

2) Provide system wide and room specific monitoring and management including:

a) System power status including power status of rack-mounted AV equipment and ceiling mounted display equipment.

b) Projector Lamp status, including estimated lamp life.

c) Room activity and system shut-down scheduling.

c. POP-3 Email Notification Programming and Set-up:

1) Provides service issue notification via pre-programmed email messages to designated service accounts ONLY if requested by end-user AV support technicians and ONLY if control system includes POP-3 mail server.

2) Co-ordinate with AV Consultant, AV support staff, and Communications/Technology management of the facility to determine proper conditions and destinations for email service.

6. LCD Touch-Panels:

a. General:

1) Owners with prior touch-panel operated systems: Panel layouts are to be programmed according to the Owner’s established layout standards and shall include a graphic layout and require approval before installation.

2) Owners without any prior touch-panel systems: Panel layouts are to be programmed for real-time demonstration and testing with end-user prior to control system installation. Help the end-user develop logical system behavior and page layouts, and incorporate any trademarks or institutional graphics into control pages as directed.

b. Button Interface:

1) Utilize visual cues to indicate button functions and states: Programmer should adorn buttons with both a unique graphic symbol and text designation wherever possible. 3D buttons verify selection by changing to a virtual "depressed" state, indicators change color or intensity when engaged, etc.

2) Optimize icons and pages for aesthetics: Graphics should be higher than 8-bit, with alpha channels where appropriate. Programmer should limit text to three unique fonts or fewer. Consult a color wheel to minimize discordant color schemes, and maintain a uniform layout throughout all pages.

3) Optimize control logic and layout for usability: Minimize the use of industry specific language (i.e. “Balanced input 3b” instead of “Lectern Mic”) and avoid confusing or limiting macros (i.e. the screen automatically comes down when the user intends to use the DVD player to play a Compact Disc). Optimize the Graphical User Interface for logical and intuitive operation by first-time users.

K. Racks, Cables, Connectors, and Miscellaneous Equipment:

1. Wiring and Interconnections:

a. General:

1) Exercise care in wiring to avoid damage to cables and equipment.

2) Make all joints and connections with rosin-core solder or approved mechanical connectors, except mechanical connectors are NOT acceptable on microphone lines. Connections to transformer leads for distributed loudspeakers may be made using properly-sized wire nuts or nylon-insulated pigtail crimp connectors such as Waldom CE series. Wire nuts are not acceptable except at individual loudspeakers.

3) All connections to screw-type terminals shall be made using spade lugs. Bare or tinned wire is not acceptable.

4) All connections to lugless compression-type screw terminals shall be made using bare wire only. Do not tin wire.

5) All wiring executed in strict adherence to standard broadcast practices. This includes:

a) Dress cables in conveniently sized bundles, combed into parallel runs, either laced or banded with sufficient plastic ties.

b) For equipment mounted on glides, or otherwise requiring servicing from the front of the rack incorporate a cable "service loop" of sufficient length to permit the equipment to be pulled forward from the rack for servicing.

c) Support cables and bundles with sufficient plastic ties and support bars to ensure that no strain is placed on any connections or connectors.

d) Organize cables and cable bundles behind patch bays to permit easy access to the patch panels to add or remove cables.

e) Place cable markers 3"-5" back from video connectors to permit easy viewing. Do not bind markers into cable bundles.

6) All audio signal lines carried by twisted-pair cable and switched with two poles per line unless noted otherwise. Do not tie one side of audio line to other audio lines.

b. Grounding:

1) Ground equipment, racks, and audio line shields to independent audio system ground ONLY as shown on drawings. If not shown on drawings, ground case of power striplines in equipment racks to the racks and directly to isolated ground buss in the power panel or to power system ground at the building AC service entry only.

2) Ground all conduits ONLY to power system ground. Insulate all conduits and electrical boxes from sound system, including equipment racks and audio system ground.

3) Insulate all conductors in conduit, including shields, from the conduit, back boxes, and from each other for the entire conduit length.

c. Equipment Racks:

1) Install equipment in racks to permit access to all equipment for service. Transformers, relays, terminal blocks, etc., mounted in rear of racks behind other equipment shall not prevent access to equipment connections or shall be mounted on hinged panels to permit access.

2) Wire all racks completely in the shop. No internal rack wiring to be done on the job site.

3) Install equipment in racks with ventilating panels as required to provide adequate ventilation and according to equipment manufacturer's recommendations.

4) Connect all microphone, DC control, and line level cables to equipment racks via specified audio terminal blocks. External lines to patch bay terminated directly on patch bay terminal blocks.

5) Connect loudspeaker lines with equipment racks via specified terminal blocks. Use spade lugs if barrier strips are used. Do not buss commons together. Do not ground.

6) No signal or control lines shall leave a rack without connecting via terminal blocks.

7) Provide unused panel space with blank or ventilating panels as shown on drawings.

8) Locate free-standing racks as indicated and to provide access to rear.

d. Conduit:

1) Run all lines in metallic conduit or wireways unless otherwise indicated. Run microphone level, line level, loudspeaker level, and DC control wiring each in separate conduit.

2) Do not locate AC power lines in conduit containing audio or video lines.

3) Do not splice lines in conduit.

e. Exposed Cables:

1) Line level or mic level lines exposed above countertops (such as those lines serving mixing consoles, program source equipment, etc.) shall be rubber-jacketed, AWG #20 two conductor with braided shield such as Belden 8412 or equivalent. Plastic or vinyl jacketed cables are not acceptable.

f. Receptacles:

1) Provide finish sample for approval by Design Professional.

2) Wall-mounted receptacles in metal boxes at building standard receptacle height unless otherwise indicated.

3) Floor-mounted receptacles in flush floor boxes with flush lids.

g. Unbalanced Receptacles:

1) Install 1/4" phone or RCA jacks to mounting plates with insulating washer and sleeve to electrically isolate the jack from the electrical box and conduit.

h. Video Receptacles:

1) Install feed-through BNC receptacles to mounting plates with insulating washer and sleeve to electrically isolate the receptacle from the electrical box and conduit.

2) Punch receptacles with "D" hole to prevent receptacle rotation within hole.

i. Loudspeaker Wiring:

1) Loudspeaker lines installed outside of conduit use UL listed Teflon cable. Lines installed loosely or otherwise on top of ceiling tiles, ductwork, etc., are NOT ACCEPTABLE.

3.3 System Performance Tests And Adjustments

A. Test all equipment to verify conformance with manufacturer's performance specifications and with this specification.

B. Audio Systems:

1. Absolute Impedance:

a. Set any loudspeaker level controls at zero attenuation. Measure absolute impedance value of each loudspeaker line at 250, l000, and 4000 Hz, without amplifier connected but with all loudspeakers connected. Impedance shall be at least 90% of rated load impedance of respective amplifier. Check resistance of lines to all loudspeaker and microphone receptacles, with receptacles open and short-circuited.

2. Hum and Noise Level:

a. Adjust gain controls for optimum signal-to-noise ratio and full amplifier output with -55 dBm level at a microphone input and 0 dBm at line-level input.
b. Without changing gain, terminate microphone and line-level inputs with shielded resistors of l50 and 600 ohms, respectively.
c. Measure overall hum and noise level at each power amplifier output for each input channel. Level shall be at least 80 dB below rated power output of amplifier over a bandwidth of 20-20,000 Hz.

3. Electrical Distortion:

a. Load power amplifiers with resistors matching nominal impedance of output terminals used in system in place of actual loudspeaker loads.
b. Adjust gain controls as for hum and noise level tests.
c. Apply 1000 Hz size-wave signal from an oscillator having less than 0.l% total harmonic distortion to each microphone and line-level input at level required to produce measured full amplifier output.
d. Distortion shall measure less than 0.1%.

4. Parasitic Oscillation and RF Pickup:

a. Set up system for each specified mode of operation.
b. Use 50 - 100 MHz bandwidth oscilloscope and loudspeaker monitoring.
c. Check to ensure that system is free of spurious oscillation and RF pickup in the absence of any input signal and also with system driven momentarily to full output at l60 Hz.

5. Buzzes, Rattles, Distortion:

a. Apply high-quality music signal to the system. Adjust the system for frequent peaks at its specified maximum sound pressure level.
b. Apply sine-wave sweep from 50-50,000 Hz at 6 dB below full amplifier power.
c. In both cases, listen carefully for buzzes, rattles, and objectionable distortion.

d. Correct all causes of such defects. If cause is outside the system, promptly notify the Owner or Owner's authorized representative and his Consultant, indicating cause and suggested corrective procedures.

6. Level Balance: Adjust level controls for all items of similar equipment for identical measured voltage gain.

7. Measure system acoustical performance using a sound level meter set for "slow" meter damping except as otherwise noted, and flat response with random incidence at a height of 4 to 5 feet. All interior finishes and furnishings shall be in place, and system gain shall be adjusted to provide levels of 70 to 80 dB and at least l0 dB above background noise at the measuring locations for these tests, except as otherwise noted. Include the following tests and adjustments:

   a. Frequency Response:

      1) Measure loudspeaker frequency response with all control equalization set for flat response, using l/3-octave bands of filtered pink noise centered on ANSI preferred frequencies, or broadband calibrated pink noise measured in l/3-octave bands using a calibrated real-time analyzer.

      2) Adjust equalization to provide average system response within ± 3 dB of a response (0 dB) which is flat from 63-2500 Hz and slopes uniformly from 0 dB at 2500 Hz to -5 dB at 10,000 Hz.

   b. Uniformity of Coverage:

      1) Use 4000 Hz octave band of random noise as test signal output to loudspeakers.

      2) Lateral Uniformity: ± 2 dB at all positions equidistant from front of hall.

      3) Front-to-Back Uniformity: Decreasing linearly within ± 2 dB from 0 dB at front of hall to -6 dB at rear as measured on the hall center line.

   c. Maximum Output Level:

      1) Measure with standard "fast" meter damping.

      2) Loudspeaker Cluster: Capable of providing 95 dB SPL in the audience area on axis of any high-frequency horn and employing wideband recorded music as a test signal.

      3) Distributed Loudspeaker Systems: Capable of providing 95 dB SPL on axis of any loudspeaker and using wideband recorded music as a test signal.

C. Video Systems: Test the video system following the approved Proof-of-Performance Test Plan to verify that it meets these minimum performance requirements. Video tape machines are exempt from these system requirements.

1. Video Standards:

   a. Frequency Response: ± 0.5 dB, 60 to 4.l8 MHz.
   b. Crosstalk: -40 dB at 3.58 MHz.
   c. S/N Ratio: 45 dB, DC to 4.l8 MHz, unweighted, peak to RMS.
   d. Hum: <10 mV peak to peak.
   e. Line and Field Tilt: 2% with 60 Hz square wave.
   f. Differential Gain: 1% at 3.58 MHz, l0-90% APL.
   g. Differential Phase: ± 1° at 3.58 MHz, l0-90% APL.

h. Envelope Delay: ± 0.l microseconds, 0.2 to 2.1 MHz; ± 0.05 microseconds at 3.58 MHz.
i. Color Production: Primary and Complementary Colors (R, G, B, Cy, Yl, Mg) at 75% saturation within inner 50% of the inner boxes (± 2.5°) when viewed on vectorscope.
j. Signal Levels: 1 V p-p, ± l IRE, at 100% peak white color bar.

2. Audio Standards:

a. Frequency Response: ± l dB, 30-l5,000 Hz.
b. Hum and Noise: -80 dBu, 30-l5,000 Hz, unweighted.
c. Distortion: 0.25% THD, 30-l5,000 Hz.
d. Signal Levels: +4dBu.

D. Remote Control Systems:

1. Test each function of each control station to verify proper operation and that each illuminated switch and indicator operates properly when the associated function is selected. Provide written report identifying each function and verifying operation of all functions on all panels in the following manner:

Room	Location	Panel Type	Screen	Button	Operation
Conf. Rm. 148	Lectern	TPS-6000	Slide Ctl.	Power ON/OFF	OK
"	"	"	"	FWD	OK
"	"	"	"	REV	OK
"	"	"	"	Focus In	OK

E. Test Reports and Certificates:

1. Submit results of all tests and adjustments conducted above and certification that the installation is complete and ready for checkout as specified under SUBMITTALS in PART 1 - GENERAL.

3.4 Final Adjustments And Acceptance Tests

A. Upon approval of the contractor's test report, and at a time set by the Owner or Owner's authorized representative, assist the Consultant(s) in performing final system adjustments and acceptance tests. Provide all labor, material, tools, and measurement equipment necessary for these tests and adjustments, including the test equipment and material specified in Article 1.1, except as otherwise specified.

B. The contractor's representatives assisting in performance of these tests shall be thoroughly familiar with all details of the system, and shall include the field supervisor in overall charge during the course of the installation work.

C. Budget 16 working hours for the performance of these tests and adjustments. If final acceptance is delayed beyond this period because of installation not in accordance with these specifications, pay for all additional time and expenses of Consultant(s) during any resultant extension of the acceptance testing period.

D. Acceptance tests may include speech intelligibility surveys and subjective evaluations by observers listening at various positions under various operating conditions, using speech, music, and live or recorded effects material.

E. Measurement of frequency response, distortion, noise, or other characteristics may be performed on any item or group of items deemed necessary to determine conformity with specifications.

F. Adjustments: Adjust the system as instructed by the Consultant. Adjustments may be required to any portion of the system including:

1. Equalization and level balance.

2. Changes to or installation of resistive pads and R/C networks.

3. Timing and programming of the audiovisual control system.

3.5 Training

A. The Owner may assign personnel to participate with the contractor during installation. Without delaying the work, familiarize the Owner's personnel with the installation, equipment, and maintenance.

B. During tests and adjustments, permit the Owner's personnel to observe. When feasible explain the significance of each test.

C. After the completion of FINAL ADJUSTMENTS AND ACCEPTANCE TESTS, provide on-site training to the end-user to instruct them on the proper use of each system, including:

1. Conduct a separate training session for each discreet system type installed.

2. Explain operation of control systems and overall function of installed systems to staff selected by the Owner as “requiring general instruction”.

3. Explain operation of control systems, set-up and operation of individual pieces of equipment (including booth equipment), functions of overall systems, and rudimentary service guidelines to staff selected by the Owner as “requiring technician level instruction”.

4. After successful training, a repair sequence (schedule of responsibility, response tree, etc.) should be established with any “technician level” staff, designated by the Owner as responsible for audiovisual systems operation and maintenance, to expedite service calls.

END

Section 281600 Security System

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Components and subsystems indicated for a complete and operable Security System as indicated and specified and as follows:

1. Security System upgrade shall include the following sub-systems:

   a. Access Control System.
   b. Internet Protocol Video Surveillance System (IPVS).

2. In order to provide proper coordination, uniform quality and system integrity, equipment and installation specified within this Section shall be provided and installed by a single Contractor having been involved with sale, installation and servicing of similar systems of size, scope and complexity of this Project for past five (5) years.

3. Attic Stock: At the completion of the project, furnish to the owner a minimum quantity of 5 percent of the installed quantity for each installed type of camera and each installed type of card reader, but not less than one (1) of each type.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Door Hardware: Division 08.

C. Electrical Work: Division 26.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. All Drawings and Product Data required for the security system shall be provided in one package. Drawings submitted without Product Data or Data submitted without Drawings will be rejected without review. Failure to provide complete documentation as indicated shall be cause for immediate rejection without comment.

C. Shop Drawings: To Design Professional for approval.

1. Before construction related to this Project is started, the security system provider shall meet with the installing Electrical Contractor to develop Shop Drawings for the Project. Shop Drawings submitted to the Design Professional for approval shall include point-to-point wiring diagrams for each new component of the security systems specified in this Section. Point-to-point wiring diagrams shall detail each device location and all wire runs between the device, all other equipment and all proposed wire runs to central systems equipment. Shop Drawings shall detail all connections between all new and all existing equipment and devices. Point to point drawings shall consist of one of the two following methods:

   a. Method No. 1: Computer generated floor plan drawings shall be provided for each area where work associated with this Project is occurring. The floor plan drawings shall detail each system device at its proposed location. Each device indicated on the floor plan drawings shall be assigned an identification number. This method would also include an accompanying riser diagram showing all new devices and all proposed wiring between devices. Devices on the riser drawing shall be keyed to the device locations and device identification numbers indicated on the floor plan drawings.
   b. Method No. 2: Computer generated floor plan drawings shall be provided for each area where work associated with this Project is occurring. The floor plan drawings shall show each device location and on the same drawing, wiring that has been added to outline the proposed wiring that is planned for this Project.
   c. Actual conduit and wire routing is not required to be detailed on point to point drawings.

2. Security riser diagrams provided shall detail the number of Access Control Panels (ACPs), power supplies and other equipment at each associated ACP location. All riser drawings submitted shall also include all cabling, wiring and all components proposed to be provided for all security related equipment and shall detail the connections between new security related devices and the central Access Control and Security Monitoring System equipment.

3. IPVS riser diagrams provided shall detail exact IPVS equipment and wiring at each IPVS component location. All IPVS related riser drawings submitted shall also include all cabling, wiring and all components proposed to be provided for head end IPVS equipment.

4. Coordination Details: Show all details required to demonstrate that all related equipment and other related systems have been coordinated with Finish (Door) Hardware: Division 08 Contractor and shall properly function as a complete Security System.

5. Shop Drawings shall include a complete bill of materials for the Project. The bill of materials submitted shall identify exact model numbers and the quantity of devices provided for each device type planned for this Project.

D. Product Data: To Design Professional for approval. This shall include a complete bill of materials for each system, data sheets on all systems and components, block diagrams of their inter-relationships, power and standby battery requirement calculations, and specific operational theories as they relate to Project Specifications. Manufacturer's product data sheets provided shall be clearly marked to indicate the exact product/device and model of the equipment being provided for this Project.

E. Closeout Submittals:

1. Operation and Maintenance Manuals: As indicated.

2. Warranty: As indicated.

3. Service Contract: As indicated.

4. Record Documents:

   a. A separate set of Drawings shall be maintained during Construction Phase of this Project. These Drawings shall be kept neat and up to date and shall be used as the basis for Record Drawing Set.
   b. Deliver Record Drawing documentation for all sub-systems of Security System before requesting Final Acceptance of system.
   c. All original submittals shall be resubmitted. Resubmitted Drawings shall show actual installed wiring and labeling information and shall include any device or component changes made during Construction Phase of Project.
   d. Testing documentation outlined in Specifications shall be submitted with Record Documents Package.
   e. Manufacturer's published installation and instruction manuals for equipment shall also be included with Record Documents Package.
   f. Submit Record As-Built Documents documentation in accordance with Division 01.

1.4 Quality Assurance

A. Referenced Codes and Standards:

1. Factory Mutual Global (FMG)

   Listing Requirements

2. National Fire Protection Association (NFPA)

   70 National Electrical Code

3. Underwriters Laboratories, Inc. (UL)

   Labeling and Listing Requirements for Security Use

1.5 Design and Performance Criteria

A. General: All systems provided shall have a record of successful operation of not less than one (1) year on applications similar to this Project, unless otherwise indicated, and shall be specifically designed for security applications. Adaptation of equipment designed for other purposes are not acceptable.

Part 2 Products

2.1 Access Control System

A. Approved Manufacturer, Special Requirements: The Access Control System shall be manufactured by Schneider Electric (formerly TAC Andover Controls). All new Access Control System devices and equipment installed as part of this Project shall be compatible with and will be connected to the system server via local area network. The existing card readers were manufactured by HID. All new card readers and cards provided shall match with the existing readers and cards.

B. Access Control Panels (ACPs):

1. Each ACP provided shall be microprocessor-based intelligent devices and shall be interconnected with the system server via local area network (LAN) as specified and indicated on system details.

2. Each ACP unit shall be housed in a common NEMA 1 enclosure with hinged door and key lock along with ACP modules. The mounting of exposed equipment directly to walls or backboards or the use of multiple enclosures is not acceptable.

3. ACPs shall control access to given areas of the facility by authorized cardholders. Each individual card number that is required to be used at the ACP shall be stored locally in the ACP database.

4. Each ACP within the system shall contain its own microprocessor, real-time clock, memory and other hardware required such that each ACP within the system shall process data received from connected ACPs and related input devices, and make output decisions based on the processed data. Systems which are designed to make access decisions at the server level for locally controlled functions in lieu of at the ACP level are not acceptable.

5. Adequately sized low voltage power supplies shall be provided at each location where combination ACP units are located. Power supplies shall be capable of providing power to all components of the ACP unit. All power supplies shall be configured for direct hardwired connection to a 120VAC circuit. Power supplies provided with electrical plugs or transformers designed for duplex receptacle mounting are not acceptable.

6. ACP shall contain 4MB of Random Access Memory and shall hold in memory a database of a minimum of 250,000 individual card numbers.

7. ACP shall activate door locks and other card reader related system outputs based on any or all of the following:

   a. Time-of-day schedule.
   b. Input switch or contact closure.
   c. Access card presentation.
   d. Manual command from a security workstation.
   e. Alarm input from the building fire alarm system.

8. Under normal conditions, the ACP shall report all alarm or transaction information directly to the existing Card Access and Security Monitoring System server in an immediate real-time mode.

9. ACP shall include a buffer, which shall store a minimum of 1 million events for periods when the ACP loses communication with the security system server.

10. Provide with each ACP a network interface module for connection of the ACP to the local area network. Interface module shall be as recommended by the access control system manufacturer.

11. Whenever communications with the server has been resumed after a communications failure or power loss, ACP shall automatically transmit all alarm messages accumulated in its buffer to the server for processing.

C. Proximity Card Readers:

1. Card readers shall utilize dual smart card and proximity-type technologies. Card readers utilizing any other form of technology are not acceptable.

2. Proximity card-reading sensor shall be a sealed unit with no moving parts. Sensor shall connect to ACP via cable as specified by manufacturer. Sensor shall detect coded information on card and send information to ACP for processing. As a minimum, sensor shall detect command codes when a card is not less than 2 inches of its surface.

3. No special housing or treatment shall be required for outdoor use. Sensors shall be factory-sealed, weatherproof and vandal-resistant.

4. Card readers installed as part of this project shall be HID RP15 or RP40, as applicable for the installed location.

5. Back boxes for all card readers shall be provided.

D. Locks, Boosters and Electric Operators:

1. Electric locks, new doors (see door schedule), request-to-exit devices and power transfer hinges shall be provided.

2. Security equipment supplier shall coordinate required electric lock voltages and maximum current levels of all equipment requiring interface with Card Access and Security Monitoring System.

E. Magnetic Personnel Door Switches:

1. Door switches used on personnel doors shall be provided.

F. Request-To-Exit (REX):

1. Request-to-exit shall be provided by way of micro-switch integral to door hardware.

2. All devices shall be specifically designed for request to exit applications. Devices specifically designed for other security related applications shall be unacceptable.

G. System Cable: System Contractor shall provide cable recommended in writing by Card Access and Security Monitoring System manufacturer. No substitutions.

2.2 IP Video Surveillance System

A. All cameras shall be manufactured by DuTel.

B. Interior Fixed Position Cameras:

1. Interior Fixed Cameras shall be native Internet Protocol (IP) Power over Ethernet (POE) type. Fixed cameras shall be Megapixel resolution (1280x960) as indicated on floor plans. Cameras shall be equipped with electronic sensitivity enhancement to increase clarity, color and detail. Each camera shall be provided with a varifocal, auto-iris lens with a range of 2.8mm to 9mm. Each camera shall operate on a voltage source from POE Ethernet switch. Interior fixed cameras shall be DuTel model CM-3100.

C. Interior PTZ Cameras:

1. Interior PTZ cameras shall be native IP POE type with VGA resolution (640x480) where indicated on floor plans. Cameras shall be equipped with electronic sensitivity enhancement to increase clarity, color and detail. Each camera shall be provided with an auto-iris lens with a range of 3.8mm to 83mm. Interior PTZ cameras shall have a zoom capability of 22x optical and 10x digital. Each camera shall operate on a voltage source from POE Ethernet switch. Interior PTZ cameras shall be DuTel model CP-2100.

D. Exterior PTZ Cameras:

1. Exterior PTZ cameras shall be native IP 24VAC type at VGA resolution (640x480) where indicated on floor plans. Cameras shall be equipped with electronic sensitivity enhancement to increase clarity, color and detail. Each camera shall be provided with an auto-iris lens with a range of 3.8mm to 114mm and exterior rated enclosure including heater and blower. Exterior PTZ cameras shall have a zoom capability of 30x optical and 10x digital. Exterior PTZ cameras shall be DuTel model CP-2100.

2. Outdoor IP PTZ camera power supplies shall be outdoor rated 24VAC 100VA with a single fused 4A output.

E. IPVS Power Wiring and Video Ethernet Cable

1. IPVS power wiring and video Ethernet cabling shall be provided.

Part 3 Execution

3.1 Installation

A. Provide complete installation of components, unless specified as being installed by Others, as follows:

1. Provide, in accordance with each manufacturer's written instructions, installation, enclosures, conduit, wireways, junction boxes, wiring (including power wiring) and connections for all equipment and products specified in this Specification so that each system is complete and fully operational. All wiring for this Project shall be placed in conduit or MC cable, unless otherwise indicated.

2. Install all IPVS and Security System related wiring in its own dedicated conduit. Color coding shall be used throughout. Low-voltage cable and wiring shall not be run in same conduit as power wiring.

3. Card access and security equipment including, but not limited to, ACPs, power supplies, transformers, security monitoring panels, relays and terminal strips shall be cabinet-mounted and shall be placed in MDF, IDF and other designated spaces as specified and indicated.

4. Wiring run within equipment enclosures, wireways or cabinets shall be neatly bundled and permanently attached to cabinet interior.

5. Suppliers of all equipment in this Section shall provide factory-trained field technicians to supervise final connections to all Central System equipment.

6. Card Access System supplier shall be responsible for initial and final generation, loading and checking of system database for entire card access and security monitoring system. This Work shall be performed with assistance of Owner's personnel who shall act in a coordinating role for Owner to assure that input parameters, names and information are as desired by Owner, and that information is correctly entered. Database loading and checking is defined as anything required to permit proper and complete system operation, including copying of the existing card database and photo images from the existing access control system. This development shall include, but not be limited to, card database entries, report formats, necessary program time and date interval programming, time codes, access levels, required sequences, and alarm outputs to system terminals and printers. Owner shall be notified thirty (30) days before date that input procedure is started.

7. IPVS System supplier shall be responsible for initial and final generation, loading and checking of IPVS DVR database. This Work shall also be performed with Owner's assistance specified above. This development shall include IPVS initial camera/monitor sequences, camera on-screen identification labeling and recording parameters.

8. All power, control and video work required by this Specification shall be done in accordance with Electrical: Division 26 requirements.

3.2 System Labeling

A. Provide labeling and numbering required for components and wiring.

B. Each terminal block and terminal in each cabinet, rack or panel shall be individually labeled.

C. Each wiring conductor connected to terminal blocks and each final device shall be individually labeled at each end. Each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be individually labeled with number or name of particular device at each end of cable or wiring group.

D. Each wire conductor connected to a building-mounted device shall not be required to be numbered at device end if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

E. Labels utilized for this Project shall be permanent type and shall be designed for intended use. Painting of numbers on panels or equipment is not acceptable.

F. Use of embossed stick-on labels is not acceptable.

3.3 Testing

A. General System Testing:

1. Field tests shall be performed by factory-trained field technicians with Owner's Representatives in attendance.

2. Tests shall be performed on each circuit and component of each system.

3. On circuit where malfunctions occur, each component within malfunctioning circuit shall be repaired and thoroughly retested.

4. Each circuit or component that could possibly be related to malfunctioning circuit shall also be retested.

5. Submit field test report to the Owner’s Representative at completion of each day's testing outlining tests performed and verifying completion or problems incurred with each test. Report shall be prepared by Security Contractor's technical personnel after each day's testing is complete.

6. Contractor shall continue test procedures until all devices and sequences are complete and functioning properly, and until all system testing has been completed.

7. Contractor shall demonstrate to Owner's Representative that all sequences operate correctly, and that all products, devices and system software operates as designed and specified.

3.4 Warranty And Service Contract

A. Contractor shall guarantee wiring and equipment for this system to be free of defects in workmanship and material for a period of one (1) year from Date of Acceptance by Owner. Beneficial use of any system shall not be considered as acceptance.

B. Expand Owner's Representative's current Preventative Maintenance Contract to cover additional system equipment four (4) hour guaranteed emergency response service and Scheduled Preventive Maintenance at time of system acceptance. Four (4) hour response time shall be provided during normal working hours only. During non-normal working hours, 12 hour response is acceptable. This contract shall be provided at no additional cost for first year.

C. Contractor shall, at time of bidding, include cost of a full-coverage Preventative Maintenance Contract similar to above Contract for second year.

END