SECTION 27 05 00 – COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 GENERAL

A. The work described herein and on the drawings consists of labor, materials, equipment, programming, testing, and other services necessary to provide and install the systems called for within Division 27 or 28. Any labor, material, programming, testing, etc. not specifically mentioned within these specifications or not shown on the drawings but required for proper performance of the system and completion of the work of this project shall be provided and installed by the Contractor.

B. It is understood that the Contractor may employ Installers to accomplish the actual installation of the systems outlined herein. Use of the term “Installer” shall not relieve the Contractor from responsibility to complete the work in accordance with the intent of the contract documents.

C. Where conflicts exist the most stringent requirement shall apply.

1.2 RELATED DOCUMENTS

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

1.3 RELATED SECTIONS

A. Comply with applicable requirements of the following divisions and sections, including additional information outlined within this section and other Division 27 sections:

1. Division 01 section “Project Management and Coordination”
2. Division 01 section “Submittal Procedures”
3. Division 01 section “Product Requirements”
4. Division 01 section “Closeout Procedures”
5. Division 01 section “Warranties”
6. Division 07 Section “Firestopping”
7. Division 08 Section "Access Doors and Frames."
8. Division 09 Section "Interior Painting"
9. Division 26
10. Division 27
11. Division 28

B. The requirements outlined within this section shall apply to all other Division 27 or 28 sections. Refer to individual Division 27 or 28 sections for requirements in addition to those outlined herein.

1.4 DEFINITIONS

A. NEC: National Electric Code, NFPA 70

1.5 SUMMARY

A. Section Includes:

1. General

a. Standards, Codes, References and Regulatory Requirements
b. Quality assurance
c. Submittals
d. Requests for substitution
e. Requests for information
f. Project Conditions
g. Delivery, Storage and Handling
h. Coordination
i. Closeout document
j. Warranty
k. Maintenance Service
l. Spare Capacity
m. Extra Materials
n. Testing
o. Owner Training

2. Products

a. General
b. General Pathway Requirements
c. Conduit bushings
d. Pull strings
e. Labels

3.

4. Execution

a. General
b. Pathways
c. Grounding
d. Terminal Boxes, Junction Boxes, and Cabinets
e. Cables/Wires
f. Outlets
g. Raceway Identification
h. Labels
i. Protection And Cleaning
j. Testing
k. Demonstration

1.6 STANDARDS, CODES, REFERENCES AND REGULATORY REQUIREMENTS

A. The requirements for the Division 27 or 28 systems outlined in the drawings and these specifications comply, to the best of the Designer’s knowledge, with applicable codes at the time of design. However, it is the Contractor's responsibility to coordinate and

verify the requirements of the Authority Having Jurisdiction over this project. The Contractor shall submit in writing any discrepancies to the Designer immediately upon discovery.

B. The Contractor shall comply with applicable Standards, Codes, References, and Regulatory Requirements outlined below as well as those additional requirements outlined in individual Division 27 or 28 sections.

C. The equipment and installation shall comply with the current and applicable provisions of the following standards, codes, references, and regulatory requirements including all ratified addenda:

1. American Society for Testing and Materials (ASTM)
2. FCC: Federal Communication Commission Part 68 as modified by Wiring Docket 88-57.
3. NFPA 70 – National Electrical Code (NEC), 2008 Edition
    1. NFPA 262- Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces, 2011 Edition
4. UL 444 – Communications Cables
5. UL 497 – Protectors for Paired Conductor Communications Circuits
6. UL 497A – Secondary Protectors for Communications Circuits
7. UL 497B – Protectors for Data Communication and Fire Alarm Cables
8. UL 1449 – Standard For Safety, Transient Voltage Surge Suppressors.

D. The equipment and installation shall comply with the latest adopted provisions of the following codes and laws:

1. Americans with Disabilities Act (ADA): Where applicable, the system shall comply with ADA, Public Law 101-336, 1990 and with the ADA Accessibility Guidelines (ADAAG).
2. Local and State Building Codes.
    a. Florida Building Code: 2014 edition including references and revisions.
    b. Authority Having Jurisdiction: The systems shall comply with applicable Codes, Ordinances and Standards as interpreted and enforced by the local authority having jurisdiction.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by Underwriters Laboratory, and marked for intended location and application.

1.7 QUALITY ASSURANCE

A. All quality assurance requirements shall be as of the date the project bid. Failure of the Manufacturer or Installer to meet the quality assurance requirements on or before the date of the project bid shall render the Manufacturer or Installer unacceptable for this project.

B. Manufacturer: Company specializing in manufacturing the products specified with a minimum 5 years documented experience.

C. Installer - General:

1. Company or person installing system must specialize in and have been actively engaged in the business of selling, installing, and servicing the system with minimum five (5) years documented experience going back from the date the project bid.
2. The Installer shall maintain an office within fifty (50) miles of the project with capability to provide emergency service 7-days-a-week, 24 hours a day.
3. The Installer shall be a direct sales division of, or the authorized and designated distributor for, the equipment manufacturer whose product he intends to install.
4. The Installer shall own and maintain tools and equipment necessary for successful installation and testing of the system and have personnel who are adequately trained in the use of such tools and equipment.
5. The Installer shall be currently licensed by the Electrical Contractors' Licensing Board as a Statewide Low Voltage System Specialty Contractor (ES-069) unless specifically noted otherwise within an individual Division 27 or 28 section.
6. The Installer's technical staff shall be certified by the equipment manufacturer as qualified to install, program, test, adjust, and service the equipment to be installed.

D. Cabling

1. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less for all cables
    b. Smoke-Developed Index: 50 or less for Category 6 cables; 450 or less for other cables.

E. Contractor Responsibilities: In addition to other requirements outlined within the contract documents, the Contractor shall be responsible for the following:

1. Where the Contractor has questions or there are inconsistencies between Divisions or Sections or where information appears to be incomplete or incorrect, it shall be the Contractor's responsibility to confirm the requirements prior to submission of a bid.
2. Unspecified Equipment and Materials: Any item of equipment or material not specifically addressed within the contract documents and required to provide a complete and functional system shall be provided by the Contractor at a level of quality consistent with other specified items.
3. The Contractor shall be responsible for any damage to any surfaces or work disrupted as a result of his work. Repair of surfaces, including patching and painting, shall be included as necessary.

F. Where devices, cable terminations, or boxes are installed above inaccessible ceilings or behind walls, the Contractor shall, whether or not shown on the drawings, provide and install and appropriately sized access panel matching the fire rating of the ceiling or wall where installed.

1.8 SUBMITTALS

A. General

1. Submit in accordance with Division 01 section “Submittals” and specific requirements outlined in individual Division 27 and 28 sections. The Contractor shall provide submittals as outlined herein to the Designer for review. Failure of the Contractor to provide submittals for review in timely manner shall result in the Contractor being solely responsible for any remedial work necessary to meet the intent or requirements of the contract documents.
2. The Contractor shall provide complete submittals for review by the Designer and as specified herein for each Division 27 and 28 system within thirty (30) days of Notice to Proceed from the Owner.
3. The Contractor shall assemble submittal requirements for each individual section as a single package. This package shall include all Qualifications data, Product data, and Shop Drawings as outlined below. Partial submittals shall not be reviewed and shall be returned to the Contractor for completion. Individual section submittal packages shall not be combined with submittals for other specification sections. Individual section submittal packages shall be tailored to the specific requirements of the individual section.
4. The Contractor shall provide submittals in electronic format for review. Submittals shall be in PDF format. The use of other electronic formats shall not be acceptable.
    a. Where the Authority Having Jurisdiction requires approved Shop Drawings to be provided with the permit application in a format other than PDF (e.g. DWF), the Contractor, upon receipt of approved Shop Drawings (i.e. those that are stamped as “Reviewed” by the Designer with no outstanding comments), shall provide the Designer with a copy in the AHJ’s preferred format for the Designer to stamp.
5. The Contractor shall provide submittals based on the requirements of the contract documents. Requests for Information (RFI), suggestions for design changes, or other issues pertaining to equipment or installation of the system shall not delay the Contractor’s timely submission of submittal data. Issues identified by the Contractor, Installer, or Designer shall be addressed separate from the submittals and the submittal process.
6. The Contractor shall submit Shop Drawings prepared by the Installer to demonstrate the Installer understands the scope of work and project requirements. Submission of the contract drawings in an attempt to meet the requirement for submittal shop drawings shall not be acceptable.
7. Basic electrical materials shall be as specified in Section 26. Submittals for Division 27 and 28 systems are not required to include information on materials specified in Division 26. However, any basic electrical materials required for Division 27 and 28 systems and not specifically called out in Division 26 or where specifically called out in Division 27 and 28 sections shall be included with the submittals for the individual Division 27 or 28 system.
8. The Contractor shall refer to the individual Division 27 and 28 sections for additional submittal requirements.

B. Electronic Submittals Formatting

1. Electronic submittals shall comply with the following:
    a. Two files shall be provided. One file shall contain Qualifications data and Product data (e.g. all cutsheets and documentation that are typically

8-1/2 x 11" in size). One file shall include Shop Drawings of the same size as the contract drawings.

b. The Qualifications and Product data file shall be in full color and shall include fully legible literature as provided by the equipment manufacturers.

c. The Shop Drawings file shall be created in AutoCAD (hand-drawn Shop Drawings shall not be acceptable) and shall be in black and white. The use of colors (e.g. layer colors resulting from AutoCAD) shall not be acceptable. Including multiple systems in a single Shop Drawing file shall not be acceptable.

2. Revisions

a. Where the initial submission of Submittals by the Contractor does not result in a "Reviewed" stamp from the Designer, the Contractor shall resolve all outstanding items and comments from the Designer and resubmit the Submittals for further review.

b. Revisions to the Submittals shall be provided with clouds to identify changes made by the Contractor (or Installer) and deltas referenced to the date the revisions are made.

c. Revision clouds and deltas shall be such that they are easily and clearly identifiable and include all changes to the documents. Revisions to the Submittals that are not clearly identified shall not be considered valid revisions and corrections at a later date necessary to resolve the unidentified issues shall be the sole responsibility of the Contractor.

d. Where the Contractor revises and resubmits based on comments from the Designer, the original comment and the Contractor's response shall be listed in table format on the Symbol Legend sheet as noted below.

e. The Contractor shall resubmit as necessary to address and clear all comments from the Designer.

C. Qualifications

1. Submit a notarized letter signed by an officer of the installing company that includes the following statements (do not change wording except to insert information noted in brackets):

a. Currently:

1) [Company Name] did and does specialize in and has been actively engaged in the business of selling, installing, and servicing [System Name] systems with a minimum of five (5) years documented experience going back from the date the project bid.

2) [Company Name] did and does maintain an office within fifty (50) miles of the project with capability to provide emergency service 7-days-a-week, 24 hour days. [Company Name]'s office is located at [Company Office Address].

3) [Company Name] was and is the authorized distributor for the equipment submitted.

4) [Company Name] did and does own all necessary test equipment required to test the system at the completion of the installation.

2. Submit a letter from the major equipment manufacturers confirming the Installer is currently an authorized distributor in good standing with the ability to provide sales and service.
3. Submit a list of all test equipment owned including the manufacturer, model number, serial number, and last calibration date that will be used to test the system.
4. Submit a copy of the Installer's current Florida Statewide Low Voltage System Specialty Contractor (ES-069) license or other license specifically called for within individual Division 27 or 28 sections.
5. Submit a technical resume of experience for the Installer's Field Supervisor who will be assigned to this project. Resume shall be clearly marked as "Field Supervisor"
6. Submit a list of at least three (3) system projects completed within the last two (2) years of similar type and size with contact names and telephone numbers of the Owner's Project Manager for each.
7. Submit one (1) copy of each manufacturer's certification of successful completion of factory training for each member of the Installer's staff who will install, program, test, or adjust the system to be installed.
8. The use of Sub-Installers (i.e. Installers two levels removed from the Electrical Sub-Contractor) shall not be allowed.

D. Product Data

1. Submit a narrative for each system outlining the sequence of operation.
2. Submit original cutsheets, as provided by the manufacturer, for each piece of equipment, material, cable, etc. to be provided and installed as part of the system.
    a. Cutsheets shall provide full technical specifications for each piece of equipment being submitted on.
    b. Scanned documents that are faded, skewed or illegible shall not be acceptable.
    c. Copies of non-technical information, cutsheets from distributor's catalogs, or screen prints from web site pages, etc. shall not be acceptable.
    d. The first page of each product cutsheet shall identify the specification section and paragraph in the upper right hand corner of the page for which the Contractor is submitting (e.g. Place "Section 27 10 00, Paragraph 2.1" or similar)
    e. Each cutsheet shall clearly identify, either through highlighting or a stamped arrow, the exact model number of each piece of equipment or material to be provided and installed.
    f. Each cutsheet shall clearly identify the specification section number and associated paragraph number that the individual piece of equipment is being submitted for.
3. In addition to the above, the Contractor shall, prior to submitting, verify the following are included:
    a. Flush grade pull boxes.
    b. Specialty terminal cabinets.

c. Each type of wire and cable to be installed as part of the system. Cable cutsheets shall be labeled with the same identifier used in the Matrix to be included in the Shop Drawings to ensure clarity in regard to which cable(s) is required for each device.
d. Connectors and required tooling.
e. Terminations system components for each cable type.
f. Cable suspension J-hooks, cable fasteners, etc.
g. Grounding and surge suppression system components for the system portion of the project.
h. Installation manuals for each active (i.e. powered) piece of equipment to be installed as part of the system.
i. Operations manuals for each active piece of equipment or software application to be installed as part of the system.

E. Shop Drawings

1. Submit complete shop drawings (using AutoCAD 2010 or later) showing how the Contractor intends to install the system. Shop drawings shall, as a minimum, include the following:

a. Symbol Legend sheet showing:

1) Unique symbols for all system racks, cabinets, panels, equipment, and devices to be installed.

b. Cable matrix showing:

1) All system cables to be installed as part of the system.
2) A unique identifier for each cable type that will be applied to each run shown on site, floor, and enlarged plans.
3) Each cable’s type, manufacturer, and model number.
4) Revisions: As noted above, the Contractor shall provide in table format a listing of the review comments and their responses. The format shall include 1) the original review comment and 2) the Contractor or Installer’s response to each item even though the submittals may have been modified where the original comment was made. Providing comment responses either as a separate document or as part of the Qualifications and Product Data PDF is not acceptable.

c. Phasing Plan sheet showing:

1) The order in which work will be accomplished. Identify phases as planned for construction. Where the Contractor determines phasing is not required for a system the requirement for the Phasing Plan may be omitted but the submitted Site Plan (or Floor Plans where the project includes no site work) shall include the statement “No phasing of work sequences required”.
2) Temporary infrastructure (conduit and cabling sizes and quantities) for each system affected. Clearly note how the Contractor plans on maintaining existing systems in a functional condition in areas that the Owner will continue to occupy during construction.

d. Floor Plan sheet showing:

1) System equipment racks, cabinets, panels, terminal cabinets, and pull boxes that are not installed in Communications Rooms.

2) Backbone conduit runs that are installed above ceiling or in other interstitial spaces within the building. Conduit sizes, quantities, and cable installed within shall be noted.

3) System devices, pull boxes and other materials to be installed as part of the system as the Contractor intends to install them.

(a) Devices that will be mounted at heights other than standard 18" A.F.F. will have height noted next to the device.

(b) Devices that will be installed in wet locations shall be noted as weatherproof

(c) Each device shown on floor plans shall include the faceplate label information specific to that device.

(d) Each system device that is provided with a Category type cable (i.e. Category 3, Category 5e, Category 6, etc.) shall be provided with an approximate cable length – as a way of showing preliminary compliance with the 100 meter rule requirements -- based on how the Contractor intends to install the cable that can be verified at the end of construction against the cable testing results provided by the Contractor for review prior to requesting a Substantial Completion walk-through as noted elsewhere in this section.

4) Conduit or J-Hook runs connecting devices to termination equipment. Contractor shall accomplish preliminary coordination with other trades and shall show conduit and J-hook runs as he intends on installing them, including cables by identifier and quantity.

(e) In order to show that inter-discipline coordination has been accomplished, the Shop Drawings for each system shall have mechanical equipment and ductwork (based on the Mechanical Installer's approved Shop Drawings) referenced into the system drawings and screened at 50% to show how conduit and cable routing will avoid conflicts.

(f) Each conduit run shown in Shop Drawings shall include quantity and size of conduit as well as quantity and type of cabling contained therein using Cable Matrix unique identifier(s).

(g) Each J-Hook run shown on Shop Drawings shall include j-hook sizes as well as quantity and type of cabling contained therein using Cable Matrix unique identifier(s).

5) Conduit sleeve locations including quantities and sizes of sleeves for each system at Communications Rooms, above ceiling walls (rated or otherwise), and in hard ceiling locations.

(h) Shop drawings shall include references to rated wall locations as noted in the project's architectural drawings.

(i) Shop drawings shall include references to hard ceiling locations as noted in the architectural drawings.

6) Required interconnections to other systems. Where interconnection with other systems is more than one (1) pair of conductors the Shop Drawings shall include a detail showing the exact method and arrangement of the interconnection including required equipment and cabling.

e. Enlarged Plan sheets:

1) System equipment racks, cabinets, panels, terminal cabinets, pull boxes, wall mounted plywood backboard, ground bus bars, and other equipment and materials to be installed as part of the system.

(j) In order to show that inter-discipline coordination has been accomplished, the Shop Drawings for each system shall show equipment for other systems screened at 50% in the enlarged plans.

2) Whether in Communications Rooms or other building spaces the Contractor's Shop Drawings shall show each piece of equipment as he intends to install it. Any conflicts with other building systems shall be identified and resolved prior to the starting the submittal process.

f. Elevations sheet showing:

1) Shop drawings shall include elevations of Communication Room walls where system equipment will be installed. Elevations shall show the coordination of all wall and floor mounted equipment as the Contractor intends to install them. Equipment and materials shown in elevations shall be to scale.

(k) In order to show that inter-discipline coordination has been accomplished, the Shop Drawings for each system shall show equipment for other systems screened at 50% in the elevations.

g. Details sheets showing:

1) System Point-to-Point Wiring Diagram: The Contractor shall include in his Shop Drawings a Point-to-Point Wiring Diagram that includes all equipment, devices, cabling, signal types, and interconnections to other systems or equipment as necessary to show a logical diagram of how the system's parts and pieces are interconnected. The diagram shall identify all system cables identified by quantity and type outlined in the Cable Matrix noted above.
2) Terminal Cabinet Layouts
3) Front Elevations: of system equipment racks and cabinets showing any system equipment not shown on the front elevations.

4) Rear Elevations: of system equipment rack and cabinets showing any system equipment not shown on the front elevations.
5) Detail of each systems ground bus bar in each Communications Room showing anticipated bonding conductors (e.g. building electrical system, building structure, equipment racks, cable tray, specific equipment, etc.). This detail may be accomplished as individual details or as a spreadsheet matrix but shall show the specific requirements for each systems ground bus bar and all anticipated bonding conductors at each location. Detail shall show size of each bonding conductor and identify the far end termination point by description and room number.
6) Details of any special or field fabricated assemblies to be installed as part of the system.
7) Faceplates: Shop drawings shall include a detail for each unique type of faceplate to be installed as part of the system. The detail shall include accurate depictions of the plate size, type, and configuration including identification of the various connectors to be installed in each. The detail shall identify the connector type and bezel color. The detail shall also include typical faceplate labeling information in the same format as the information shown on floor plans for system devices.
8) A detail outlining the Cable Labeling scheme to be used including size and type of labels, typical printing for each type of label, and identification of label types to be used with each cable as identified in the Cable Matrix noted above.
9) Submit calculations in table format for sizing of UPS's including:

(l) A matrix showing a line item for each piece of equipment to be powered by the UPS. This shall include manufacturer, model number, quantity and description in separate columns.
(m) The primary side voltage for each piece of equipment
(n) The current requirements for each piece of equipment
(o) The extended total current requirements for each line item
(p) The total current requirements for all equipment.
(q) The total power capacity of each UPS showing a minimum of twenty (20) minutes of full load run time for the total calculated wattage plus fifty percent spare capacity.

2. Prior to submitting Shop Drawings, the Contractor shall coordinate the termination equipment for each system such that there are no conflicts between building systems.

1.9 REQUESTS FOR SUBSTITUTION

A. Submit requests for substitution in accordance with Division 01 section "Product Requirements".

B. Requests for Substitution shall be submitted not less than ten (10) days prior to the project's bid date. Requests for Substitution shall be submitted in writing explaining why the substitution is being requested and how the proposed item(s) will meet or

exceed the specifications. Submitted information shall be adequate information to support the Request for Substitution or it shall be rejected.

C. Requests for Substitution after the project bid-opening date will only be accepted for review where 1) the equipment manufacturer either no longer manufacturer's a specified piece of equipment or has replaced a specified piece of equipment with another piece of equipment and 2) there is no other acceptable manufacturer listed in the specifications. In this case, the Contractor shall submit a Request for Substitution with documentation necessary to support the substitution request and confirm that the proposed substitution meets or exceeds the specified equipment in all respects. Requests for Substitution shall not result in additional cost to the Owner.

D. Where the Contractor proposes to substitute the specified cable (either copper or fiber optic) he shall provide to the Designer a complete copy of the U.L. Test report for that product. Proposed cable substitutions that are not accompanied by the appropriate U.L. test report shall be rejected.

E. The Contractor, if requested to do so by the Designer, shall be prepared to show by "proof-of-performance" test that the equipment being furnished on the job is equal to or better than the equipment specifications listed herein. This proof shall be shown by actual tests and not by printed sales literature. To this end, the Contractor shall provide qualified technicians and such test equipment as required to perform this function.

1.10 REQUESTS FOR INFORMATION

A. Due to the complexity of the system it is understood that the Contractor may need to submit Requests for Information (RFI) to the Designer in order to obtain clarifications of project requirements, advise the Designer of potential problems, or suggest methods to improve the installed system. In any instance where the Contractor feels it is necessary to submit an RFI he shall do so in a manner that allows the Designer to review and comment on the issue identified within the RFI in a timely manner. The Contractor shall include in his RFI the following information:

1. A reference to the specific drawing number and note number or specification section and paragraph number, and
2. A narrative that clearly identifies the potential issue, and
3. The Contractor's proposed solution, and
4. Costs, if any, associated with implementing the Contractor's proposed solution. If an indication of cost is not included it will be assumed no cost is associated with the Contractor's proposed solution.

B. It shall be incumbent upon the Contractor when submitting an RFI to provide any additional information (equipment cutsheets, sketches, etc.) as necessary to ensure that the Designer fully understands the issue and the proposed solution.

C. Submitted RFI's that do not include the information outlined above shall not be reviewed and shall be returned to the Contractor for correction.

D. The Contractor shall submit RFI's in a timely manner, after discovery of the issue, which allows the Designer adequate time to review and comment on the issue identified.

1.11 OBSOLESCENCE OF EQUIPMENT

A. Where a manufacturer makes a specified piece of equipment obsolete or supersedes it with a newer model, the Contractor shall provide replacement equipment that meets or exceeds the technical specifications of the original piece of equipment -- by the original equipment manufacturer or one of the listed Acceptable Substitution manufacturers or another manufacturer if no equipment is available from the Basis of Design manufacturer or no Acceptable Substitution manufacturers are listed – at no additional cost to the Owner. Replacement of the specified equipment under these conditions shall not delay the Contractor's timely submission of submittals as outlined elsewhere in this section.

1.12 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Do not deliver or install equipment, frames, cabinets, etc. until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.13 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight.
2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP, STP, or multi-conductor cable for open and short circuits.
4. Document in spreadsheet format the date, time, name of Installer personnel accomplishing test, tests accomplished, and initials of Installer's Supervisor confirming testing was completed. Maintain electronic and hard copy of documentation on site.

1.14 COORDINATION

A. Comply with the requirements of Division 01 section "Project Management and Coordination".

B. Coordinate arrangement, mounting, and support of communications materials and equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To provide code required clearances and working room in front of and around equipment, cabinets, and racks. Exceed code requirements where noted within contract documents.
3. To provide for ease of disconnecting the equipment with minimum interference to other installations.
4. To allow right of way for piping and conduit installed at required slope.
5. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

C. Coordinate layout and installation of equipment, pathways, and cabling. Coordinate service entrance arrangement with local utilities.

1. Adjust arrangements and locations of equipment with equipment and materials of other communications, electronic safety and security, and related systems that share space.
2. Modify as-built drawings to reflect adjustments.
3. Coordinate location of power raceways, circuits and receptacles with locations of equipment requiring electrical power to operate.

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

E. Coordinate location of access panels and doors for equipment that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section “Access Doors and Frames."

F. Coordinate work with other trades as necessary.

G. Coordinate work associated with Owner provided equipment as necessary.

1.15 CLOSE-OUT DOCUMENTS

A. Submit close-out documents in accordance with Division 01 section “Closeout Procedures” and specific requirements outlined in individual Division 27 or 28 sections.

B. In addition to requirements outlined in Division 01 section “Closeout Procedures” comply with the following:

1. Submit cable routings for backbone, tie, and riser cable terminations.
2. Submit an original copy, on CD, as provided by the original manufacturer, of each software program provided as part of the system.
3. Submit a hard copy and an electronic copy of the final system programming as accomplished by the Installer. The hard copy shall be a printout of the software programming code accomplished by the Installer.
4. Submit a documented list of all system passwords. The Contractor shall provide the Owner with all system passwords. The use of master or backdoor passwords known only to the Contractor or Installer shall not be acceptable.
5. Submit a “Sequence of Operation” for each system.
6. For those systems with active controls or equipment with functions and features that can be adjusted as part of the normal operation, submit detailed, written

documentation of all system settings and adjustments at the time of project completion including but not limited to:

a. Level settings for all potentiometers, switches, and other settings on all system equipment.
b. Photographs of all equipment knob, button, rheostat, slider control, switch, and other settings necessary to document the original system configuration and settings at the completion of construction. Photographs shall clearly indicate the equipment and settings. The Contractor may utilize digital photography for documentation purposes. In the event that digital photography is used, the Contractor shall provide one (1) electronic copy and one (1) color hard copy of all photographs.
c. Other applicable equipment settings as may be required by the Owner.
d. The documentation shall be formatted and presented in a manner that will allow the Owner to return the system to its original settings without assistance.

7. The Contractor shall submit a draft copy of Close-Out documentation to the Designer seven (7) days prior to requesting Substantial Completion and a final copy of Close-Out documentation to the Designer no less than seven (7) days prior to requesting Final Completion of the project. Both draft and final copies shall be submitted on a properly labeled DVD.

1.16 WARRANTY

A. Submit warranties in accordance with Division 01 section “Warranties” and specific requirements outlined in individual Division 27 or 28 sections.

B. Where a manufacturer’s stated warranty exceeds that called for in these specifications, the Contractor shall honor the manufacturer’s warranty as if it had been specified herein.

1.17 MAINTENANCE SERVICE

A. Comply with the requirements of individual Division 27 or 28 sections

1.18 SPARE CAPACITY

A. Comply with requirements of individual Division 27 or 28 sections

1.19 EXTRA MATERIALS

A. Comply with requirements of individual Division 27 or 28 sections.

B. Keys: Provide a minimum of three (3) sets of keys, identified by system and lock, for each different type of lock installed for each system. Keys sets shall be on individual key rings with permanent plastic or metal tag identifying the system, lock location, and key number.

1.20 TESTING

A. Accomplishing system testing as called for herein. Comply with additional requirements where called for in an individual Division 27 or 28 section.

1.21 OWNER'S TRAINING

A. The Contractor shall, after Substantial Completion but prior to Final Completion, provide the Owner with training on the systems within in Division 27 or 28. Individual training sessions shall be provided for each system. Combining training systems into a single training session shall not be acceptable.

B. Training shall be comprised of:

1. A walk-through of the facility to identify all system equipment and equipment locations.
2. A review of:

a. The system's Close-Out documents
b. The system's final documented test results
c. The system's Manufacturer's warranties
d. The system's software, programming, and passwords
e. The system's equipment settings and adjustments

PART 2 - PRODUCTS

2.1 GENERAL

A. The Contractor shall provide and install all equipment and materials necessary for complete, operational systems whether or not specifically shown on the drawings or specified herein.

B. The Contractor shall provide all labor, programming, and testing necessary to complete the work related to the Division 27 or 28 systems and provide the Owner, at the completion of the project, with fully functional and properly operating systems in accordance with the manufacturer's recommendations, the requirements of the contract documents, and applicable industry standards.

C. Design: Delete if no Owner-furnished equipment

D. The Contractor shall install, program, and test Owner furnished equipment where required by the contract documents.

E. Equipment and components shall be new, and the manufacturer's current model. All equipment and materials shall be suitable for use intended, and meet all stated performance requirements for the system configurations specified herein.

F. Equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

G. Unless specifically noted otherwise, equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. Fasteners and supports shall be adequate to support the required load.

2.2 GENERAL PATHWAY REQUIREMENTS

A. General:

1. Pathways (conduit, raceways, wireways, pullboxes, outlet boxes, etc.) shall comply with applicable requirements of Division 26.

B. Conduit:

1. EMT fittings shall be steel, compression type connectors, with insulated bushings and separate lock nuts on conduits entering panel cabinets.
2. Bushings: Provide insulated bushings on ends of all raceway. All metallic conduits shall have bonding bushings and be bonded to the Systems Ground Bus Bar with an insulated #6 AWG wire.
3. Pull Cords: Install pull cords in all raceway runs that are installed without cable.
4. Size:

a. Minimum size shall be as shown on the drawings.
b. The Contractor shall size raceways in accordance with the NEC for the quantity of cables to be installed unless noted otherwise.

C. Boxes:

1. Boxes shall be sized as required by NEC for cables, conduit and device installed unless noted otherwise.

2.3 CONDUIT BUSHINGS

A. General

1. Grounding Bushings: All metallic conduits shall have bonding bushings and be bonded to the Systems Ground Bus Bar with an insulated #6 AWG wire.
2. Insulation Bushings: Provide insulated bushings on ends of all raceway.

B. Manufacturers

1. Basis of Design

a. Basis of Design: Arlington EMT Series # “TBD” or acceptable substitution

2.4 CABLE SUPPORT SYSTEM

A. General

1. UL listed and labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
2. Horizontal cables shall be suspended by pre-manufactured CAT 6 rated cable hangers in closets where J-hooks, ladder tray or rack management is not available. All supports shall be permanently attached to the structure using all-thread suspension, beam clamps, or wall mount to the structural metal or

wooden members. The J-hooks shall feature a wide base loop with smooth curves to eliminate snag potential and cable deformation.

3. J-hooks are to be in accordance with the NEC, EIA/TIA requirements for structured cabling systems.

B. Project Performance Requirements

1. Cable support system J-hooks shall be provided in sizes of 1”, 1-5/16”, and 2” only. J-hooks larger than 2” shall not be acceptable.
2. J-Hooks for Voice/Data cabling shall be blue in color.
3. The use of non-metallic cable supports shall not be acceptable.
4. Cable supports shall be supported from structure only.

C. Manufacturers

1. Basis of Design

a. Erico Caddy CAT HP Series J-Hooks

2. Acceptable Substitution

a. B-Line BCH Series J-Hooks

2.5 PULL STRINGS

A. General

1. Shall be commercial grade pull string specifically designed for pulling low-voltage cables (i.e. Category 6, fiber optic, etc.) in electrical conduits and innerducts.

B. Functions and Features

1. Minimum Tensile Strength: 210 lbs.

C. Project Performance Requirements

1. Install pull strings in all raceway runs that are installed without cable.

D. Manufacturers

1. Basis of Design

a. Jet Line #232

2. Acceptable Substitutions

a. Greenlee
b. Herculine

2.6 LABELS

A. General

1. Shall be commercial grade labels specifically designed for use on low-voltage cables of all types.

B. Project Performance Requirements

1. 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.
2. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

C. Manufacturers:

1. Basis of Design

a. Brady Corporation

2. Acceptable Substitutions

a. HellermannTyton.
b. Kroy LLC.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with NECA 1.

B. The Contractor is advised that circuit routing for this system is not necessarily shown on the project drawings. The Contractor shall provide and install raceways, wiring and cabling required for complete and fully functional systems as intended by these specifications.

C. The Contractor shall provide and install a properly sized, flush mounted outlet box for every floor, wall, and ceiling mounted device.

D. In locations where pathways are not accessible after completion of the project, raceway shall be extended from device to device or fire rated access panels shall be installed to provide access to pull boxes. Routing of raceway from device to device shall only be acceptable where the wiring scheme of the system, as recommended by the manufacturer, requires cable to pass from device to device.

E. Contractor shall properly terminate each device according to the manufacturer’s recommendations. Unless specifically noted otherwise, the Contractor shall provide and install cabling to connect all circuitry associated with a device.

F. Equipment shall be installed in accordance with manufacturer's instructions.

G. Install electrical basic materials per applicable sections of these specifications.

H. Equipment, other than portable equipment, shall be held firmly in place. The exception shall be when the Contractor is required to use resilient shock mounting to decouple equipment from the structure it is being mounted to.

I. Support raceways, backboards, and cabinets per applicable sections of these specifications, as shown on the drawings, and as recommended by the manufacturer.

Fastenings and supports shall be adequate to support their loads with a safety factor of five (5).

J. Switches, connectors, outlets, etc., shall be clearly, logically, and permanently marked during installation. Where the equipment manufacturer does not provide markings or for fabricated and installed equipment the Contractor shall provide and install permanent, engraved labels for proper identification.

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

L. 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.

M. 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.

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

3.2 FIRESTOPPING

A. Contractor shall provide and install firestopping on all penetrations through rated walls and floors to match the rating of the wall or floor assembly. Refer to Division 7 for additional information.

3.3 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. 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. Install sleeves during erection of slabs and walls.

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

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

E. Extend sleeves installed in floors 2 inches above finished floor level.

F. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable, unless indicated otherwise.

G. 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.

H. 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. Comply with requirements in Division 07 Section "Joint Sealants."

I. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work. The use of pitch pockets is not acceptable.

J. 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.

K. 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.

3.4 CONDUIT

A. Conduit systems for individual systems shall not be shared by power or any other electrical wiring that is not part of the system.

B. Backbone cables shall be in a complete conduit system. Refer to the drawings for additional information.

C. Conduits run underground shall be installed a minimum of 24” below grade. Provide and install magnetic tape above underground runs to allow the Owner to easily locate in the future.

D. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.

E. Bend conduits with minimum inside radius of 6 times the internal diameter. Increase bend radius to 10 times for conduit larger than 2 inch size. Provide proper bend for all changes of direction. Pull and splice boxes shall not be used in lieu of a bend.

F. Install conduits so no more than two 90o bends are in any conduit section without a pullbox. Install additional pullboxes as required to maintain maximum of two 90o bends between pullboxes and/or termination points.

G. Install interior conduits so no more than one hundred (100) feet of conduit are in any conduit section without a pullbox. Install additional pullboxes as required to maintain a maximum of one hundred (100) feet between pullboxes and termination points.

H. Install Outside Plant (OSP) conduits and ductbanks so that no more than three hundred (300) feet of conduit are in any conduit section without a pullbox. Install additional pullboxes as required to maintain a maximum of three hundred (300) feet between pullboxes and termination points.

I. In installations where the electrical contractor does not provide a counterpoise system in conjunction with the underground conduit system, the Contractor shall provide a coupling conductor within the underground conduit system to run alongside copper

conductors. Coupling conductors shall be sized according to applicable codes and standards.

J. Label conduits at both ends to indicate destination and source. Also indicate length of conduit. This labeling/identification shall be fully documented in as-built (record) drawings.

K. Install pull string in each empty conduit over 10 feet in length or containing a bend.

L. Properly support cables/wire not installed in conduits.

M. Special Conduit Systems: Special conduit systems may be specified for some portions of the system. Refer to the drawings and other sections of these specifications to determine where or if such systems are used.

N. Use of ceiling tiles, grid or hanger wires for the support cables shall be prohibited.

O. Comply with requirements in Division 26 Section “Conduit and Boxes for Electrical Systems" for installation of conduits and wireways.

3.5 RACEWAY IDENTIFICATION

A. All conduit system junction boxes (except those subject to view in public areas) for Division 27 and 28 systems shall be color coded as listed below utilizing the Krylon colors noted:

1. Fire Alarm - Safety Orange 2410
2. Fiber Optics - Safety Purple 1929
3. Sound System - Safety Yellow 1813
4. Intercom - True Blue K1910
5. Computer/Data - Bright Gold K1701
6. TV - Glossy White K1501
7. Security/CCTV - John Deer Green K1817
8. Telephone - Safety Green 2012

B. Refer to Section 26 05 53 for additional information

3.6 GROUNDING

A. Provide and install complete grounding system as required to comply with the drawings, other Division 27 or 28 sections, Division 26, and applicable codes.

B. Communications bonding and grounding shall be in accordance with the National Electrical Code (NEC), NFPA and EIA/TIA grounding and bonding standards.

C. A 2/0 AWG stranded copper wire cable in PVC conduit shall be extended between new ground bars located at each communications room (or other location shown on drawings) and the building main electrical service ground point or secondary transformer ground point. Building steel, equipment racks and cabinets, cable tray, and surge suppressor devices shall be bonded to the ground bar via a #6 AWG stranded copper cable and UL approved connecting hardware.

D. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

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

F. Locate ground bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar.

G. Connect cable shields to ground bus bar in an industry approved manner. Connections shall be soldered or crimped.

H. The Contractor shall take such precautions as are necessary to guard against electromagnetic and electrostatic hum, and to install all equipment so as to provide maximum safety to the person who operates it.

3.7 TERMINAL BOXES, JUNCTION BOXES AND CABINETS

A. Boxes and cabinets shall be UL listed for their use and purpose.

B. Install boxes and cabinets plumb and square with wall. Where flush mounted boxes and cabinets shall be flush with wall surface.

3.8 CABLES/WIRES

A. The Contractor shall provide and install all copper and fiber optic cable required to complete the scope of work of this project. Refer to individual Division 27 or 28 sections for specific cabling requirements.

B. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

C. Cables shall not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

D. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.

E. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

F. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.

G. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

H. All cable and wire shall be new.

I. Install cables/wires in accordance with manufacturer's instructions.

J. Cables shall be installed as illustrated on the drawings except where necessary to avoid EMI sources or other obstacles. Major deviations from the illustrated path must be accepted in advance by the Designer. Where illustrated path is not show on the drawings, Contractor shall include intended, general routing path within his submittals.

K. The Contractor shall install cabling to avoiding EMI. Provide clearances of at least 48” from any motor or transformer; 12” from conduit and cables used for electrical power distribution; and 12” from fluorescent lighting. Pathways are to cross fluorescent lighting and electrical power cables and conduits in a perpendicular fashion only.

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

M. Install cables in raceways (refer to drawings) 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 Division 26 Section “Raceway and Boxes for Electrical Systems."

N. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

O. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

P. All cable terminations and testing of cable installed under this project shall be accomplished by the Contractor unless specifically noted otherwise.

Q. Cable runs shall include a service slack prior to the termination point. Provide for a 12-inch service slack in the ceiling above each outlet. Service slack in Communications Rooms shall consist of a 10-foot slack section for all station cables located and placed neatly in the cable tray above the equipment rack or cabinet.

R. Cables placed under ground, below slab on grade, in slab on grade, or in other wet locations, whether in conduit or direct buried, shall be gel-filled or water blocking type.

S. Interior backbone cables shall be Riser rated unless otherwise stated or required by code.

T. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

U. Install system wiring and/or raceways away from any surface that may become hot, including and not limited to, hot water piping and heating ducts.

V. Maintain proper separation between system cables and all power and/or unshielded cables, as required to prevent noise, crosstalk, etc.

a. Wiring crossing power circuits shall be at right angles. For metal enclosed electric light or power or Class 1 circuits, separation may be reduced as described in the National Electric Code (NEC). Increase separation if so required to comply with referenced standards.

2. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors.
3. 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 (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
4. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
5. 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 (76 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
6. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
7. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

W. The majority of the system wiring will be installed above ceilings. Cabling used throughout this project shall comply with the requirements outlined in the National Electric Code (NEC). Cabling shall bear CMP and/or appropriate markings for the environment in which they are installed.

X. Provide a minimum of two cable support hangers at corners and 90 degree turns. Attachment shall be to the building structure and framework at a maximum of four (4) foot intervals. Where cable is routed above the ceiling in areas where there are no walls, all-thread shall be used (minimum ¼"; sized to support the intended weight) with the appropriate hanger for cross-room support. Support rods shall be level and plumb after cable installation. Requirements for bending radius and pulling tension of cables shall be adhered to.

Y. Above suspended ceilings and below raised floor areas where duct, cable trays, or conduits are not available, cables shall be bundled in groups of 40 or less. Secure loosely with cable ties. Cables shall be loose enough to be rotated easily by hand. Cable ties used in plenum areas shall be plenum rated.

Z. Provide protection for exposed cables.

3.9 OUTLETS

A. The Contractor shall provide and install an outlet plate with appropriate connectors for each device whether or not shown on the drawings.

B. Install devices/inserts in outlets so that same orientation is used throughout project.

C. Install wall plates with all inserts required to properly connect all equipment circuits and complete the installation in a professional manner.

3.10 LABELS

A. The Contractor shall provide and install permanent, engraved labels on all equipment where the original manufacturer has not already provided labels.

B. Custom, fabricated, or field assembled assemblies and equipment shall be provided with permanent engraved or non-removable silk-screened labels. The Contractor shall provide samples of labels to Designer for review and approval prior to fabrication or final installation. The Contractor shall modify labeling as required by the Designer.

C. The Contractor shall provide and install a permanent, machine printed, protected label on both ends of each system cable. The label at each end of the cable shall provide the following information:

1. System identifier
2. Room number where other end of cable is terminated
    a. Where system cables are routed between buildings the Contractor shall preface the Room Number with a Building Number
    b. Room numbers shall coincide with numbering scheme included in contract documents.
3. Device identifier where other end of cable is terminated
    a. Device identifier shall provide a clear indication of device connected to.
4. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
5. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
6. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).

7. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.
8. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

D. Equipment, control, and system cabling shall be provided with permanent descriptive labels.

E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables shall use flexible vinyl or polyester that flexes as cables are bent.

F. PROTECTION AND CLEANING

A. The Contractor shall ensure that all system equipment is fully protected from damage, work of other trades, construction material, dirt, and dust to the point that upon occupancy by the Owner the equipment shall appear new and as if it had just been removed from the manufacturer’s original packing.

B. The Contractor shall be responsible for ensuring that all system enclosures and equipment is clean and in like new condition prior to requesting Substantial Completion. As a minimum, this shall include:

1. The interior of equipment cabinets, terminal cabinets, and all other system enclosures shall be free of installation remnants, construction materials, dust, dirt, and other evidence of construction.
2. The exterior of equipment cabinets, terminal cabinets, and all other system enclosures shall be free of scrapes, nicks, dents, discoloration, abrasions, excess construction materials, or other evidence of damage.
3. System equipment backboxes, outlet boxes shall be free of damage and excess construction materials that hinder the installation of equipment or reduce the interior volume of the box.
4. Equipment exteriors shall be clean and free of fingerprints, dust, stains, scratches, abrasions, marks, excess construction materials, or other contaminants.
5. All system devices shall be clean and free of damage or visible markings.

C. Field touch-up painting of racks, cabinets, and system enclosures to hide the evidence of damage shall not be acceptable. The Contractor shall replace racks, cabinets, or system enclosures that have visible exterior damage.

D. In the event that the Designer determines that the equipment has not been protected properly, evidence of damage is visible, or the degree of installation remnants, construction material intrusion, dust, dirt, or other evidence of construction appears excessive, the Contractor shall clean the equipment and enclosures to the satisfaction of the Designer or shall, at the direction of the Designer, replace the equipment with new.

G. TESTING

H. Perform testing as necessary or specified to verify fully functional systems with no visual, audible, or operational degradation. Replace and/or repair and retest components that fail performance standards. Test cables, outlets, devices, and equipment in accordance with industry acceptable practices for each individual system.

I. Provide factory trained personnel to perform the tests and adjust the system.

J. Test Equipment

1. Provide all required test equipment and associated apparatus necessary to successfully complete the system testing.
2. Kits, home-built, and other nonprofessional test equipment shall not be acceptable.
3. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

K. Cable

1. General

a. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
b. Visually inspect cable placement, cable termination, equipment and patch cords, and labeling of all components.
c. Visually confirm cables and outlets have been properly labeled.
d. Visually inspect grounding and bonding for completeness and termination tightness.
e. Test operation of shorting bars in connection blocks.

2. UTP and Multi-Conductor Cable

a. Test each cable. Perform the following tests:
b. DC loop resistance
c. Shorts

d. Opens
e. Intermittent faults
f. Polarity between conductors.

L. Corrective Action

1. The Contractor shall submit to the Designer, within five (5) business days of accomplishing the initial testing, a list identifying cables that do not meet the testing requirements. The Designer shall review the documentation and determine corrective action to be taken. This may include replacement of defective materials at no additional expense to the Owner.
2. The Contractor shall be responsible for repairing or replacement of defective equipment, materials, and cable as necessary to provide 100% satisfactory testing.
3. Remove and replace cabling where test results indicate that they do not comply with specified requirements. End-to-end cabling will be considered defective if it does not pass tests and inspections.

M. Documentation of Tests, Measurements, and Adjustments Performed:

1. Provide system verification and acceptance documentation signed and dated by the Contractor at the completion of testing. Document the following:

a. List of personnel in attendance during testing including the name of the Technician who performed each individual test.
b. List of certified test equipment used with serial numbers
c. List date of last calibration for each piece of test equipment
d. Date of each test
e. List reference settings of test equipment used for tests
f. Submit testing results in hard copy and native electronic format.

2. System verification and acceptance documentation shall be provided with the Contractor’s request for Substantial Completion.

DEMONSTRATION

A. Demonstrate system to designated Owner personnel as required by applicable sections of these specifications. Accomplish Owner’s training as described in Part 1.

B. Complete operation of the system shall be demonstrated. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

C. The Contractor shall provide a typewritten "Sequence of Operation" for each system.

END OF SECTION 27 05 01

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SECTION 27 10 00 – VOICE-DATA CABLE INFRASTRUCTURE

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Comply with the requirements of Section 27 05 00 “Common Work Results for Communications”

B. In addition to the requirements of Section 27 05 00 comply with the following requirements:

1. Definitions

a. BICSI: Building Industry Consulting Service International.
b. RCDD: Registered Communications Distribution Designer.
c. PoE: Power over Ethernet
d. VoIP: Voice over Internet Protocol

2. Standards, Codes, References And Regulatory Requirements

a. The equipment and installation shall comply with the current and applicable provisions of the following standards, codes, references, and regulatory requirements including all ratified addenda:

1) American Society for Testing and Materials (ASTM)

a) ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
b) ANSI/TIA/EIA-568-C.1, Commercial Building Telecommunications Cabling Standard
c) ANSI/TIA/EIA-568-C.2, Balanced Twisted Pair Telecommunications Cabling and Components Standard
d) ANSI/EIA/TIA-569-B, Commercial Building Standard for Telecommunication Pathways and Spaces
e) ANSI/TIA/EIA-606-A, Administration Standard for The Telecommunications Infrastructure of Commercial Buildings
f) ANSI/TIA/EIA-607-B, Commercial Building Grounding and Bonding Requirements for Telecommunications
g) ANSI/TIA/EIA-758-A, Customer-Owned Outside Plant Telecommunications Cabling Standard
h) ASTM D 4566-94, Standard Test Methods for Electrical Performance Properties of Insulations and Jackets of Telecommunications Wire and Cable
i) IEC 60603-7, Connectors for frequencies below 3 MHz for use with printed boards – Part 7: Detail specification

for connectors, 8-way, including fixed and free connectors with common mating features, with assessed quality

2) IEC 61935-1, Generic Specification for the Testing of Balanced Communications Cabling in Accordance with ISO/IEC 11801
3) Building Industry Consulting Service International (BICSI), Telecommunications Distribution Methods Manual, (Latest Revision)
4) Building Industry Consulting Service International (BICSI), Customer-Owned Outside Plant Design Manual, (Latest Revision)
5) Building Industry Consulting Service International (BICSI), Telecommunications Cabling Installation Manual, (Latest Revision)
6) Building Industry Consulting Service International (BICSI), LAN and Internetworking Design Manual, (Latest Revision)

3. Quality Assurance

a. Installer – Category 6:

1) Cabling Installer must have personnel certified by BICSI on staff.
2) Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD. Shop Drawings shall be stamped by the RCDD with direct supervision responsibility.
3) Installation Supervision: Installation shall be under the direct supervision of a BICSI certified Level 2 Installer or higher who shall be present at all times when work the work of this section is performed at the project site.
4) Field Inspector: Currently registered by BICSI as an RCDD to perform the on-site inspection.

4. Warranty

a. The Structured Cabling System shall be provided with a 25 Year Manufacturer's Warranty that covers the entire system (i.e. jacks, patch panels, patch cords, and cable). The warranty program shall include coverage for both Link and Channel configuration.

5. Spare Capacity

a. Contractor shall provide and install system equipment and materials in quantities that will provide the Owner with twenty percent (20%) spare capacity (e.g. termination points, jacks, ports, etc.) after connection of all circuits as required by the contract documents. Equipment and materials where spare capacity shall be provided include:

1) Termination Blocks

2) Patch Panels

6. Extra Materials

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

1) Termination Blocks: One of each type.
2) Patch-Panel Units: One of each type.
3) Device Plates: Three of each type.

1.2 DESCRIPTION OF SYSTEM:

A. Provide and install a complete Voice/Data Cable Infrastructure System, as described herein and shown on the drawings, providing the following:

1. Transport of voice, data, and video signals.

B. Section Includes:

1. Floor Mount Equipment Racks and Frames
2. Rack and Frame Equipment
3. Cable Support Systems
4. Horizontal Copper Cable
5. Copper Patch Panels
6. Workstation Outlets
7. Copper Patch Cords
8. Surge Suppression Equipment
9. Labels

1.3 SPECIAL REQUIREMENTS

A. Not used.

1.4 FUNCTIONS AND OBJECTIVES

A. Installation of a complete Structured Cabling System throughout the facility as described herein and shown on the drawings. The Structured Cabling System is used to transport voice, data, and video signals from various sources to end-points, devices, and other systems. The requirements called for herein apply to each other section where required to accomplish the work of this project. The Contractor shall coordinate the requirements to provide a complete and fully functional Structured Cabling System ready to accept interconnection to equipment and systems that will use the Structured Cabling System as their means of transporting signals. This coordination shall include materials (terminal blocks, patch cords, etc.) as necessary to complete the interconnection requirements.

B. Provide and install equipment and materials to support the termination and interconnection of copper cables for Horizontal portions of the Structured Cabling System.

C. Provide and install cabling, termination equipment and associated materials to support interconnection to the Horizontal portion of the Structured Cabling System.

D. Provide and install horizontal cabling, termination equipment and associated materials to support interconnection field devices and equipment with circuits from primary system equipment of the Structured Cabling System. Horizontal cabling shall be installed in raceway where shown on the drawings.

1. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect. The Contractor shall coordinate the installation of the horizontal cabling such that no individual cable shall exceed the maximum allowable horizontal cable length of 295 feet (90 m).
2. Provide termination of the horizontal cabling at project Distribution Frames (DF) as shown on the drawings. Organization of the cabling system shall be such that it will be possible, through a series of patch panels, to route any voice or data circuit to any workstation outlet jack through the use of patch cords.
3. Route horizontal cabling from Distribution Frames to Workstation Outlets utilizing approved cabling pathways.
4. Terminate horizontal cabling at the workstation locations in an organized manner that allows access to the voice and data jacks for connection of terminal equipment through the use of patch cords.

E. Provide and install all copper cables, patch panels and communication outlets and other materials necessary to provide a complete, installed system for transmission of voice, data and video signals.

F. Patch panels, workstation outlets and other associated materials shall be provided by a single manufacturer.

G. The system, as provided and installed, shall be provided with a minimum twenty-five (25) year link and channel warranty for the entire installed system from the original manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Contractor shall provide and install all equipment and materials necessary for complete, operational systems whether or not specifically shown on the drawings or specified herein.

B. The Contractor shall provide all labor, programming, and testing necessary to complete the work and provide the Owner, at the completion of the project, with fully functional and properly operating systems in accordance with the manufacturer's recommendations, the requirements of the contract documents, and applicable industry standards.

C. The Contractor shall install, program, and test Owner furnished equipment where required by the contract documents.

D. Equipment and components shall be new, and the manufacturer's current model. All equipment and materials shall be suitable for use intended, and meet all stated performance requirements for the system configurations specified herein.

E. Equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

F. Unless specifically noted otherwise, equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. Fasteners and supports shall be adequate to support the required load.

2.2 GENERAL PATHWAY REQUIREMENTS

A. General:

1. Comply with Section 27 05 00
2. Pathways (conduit, raceways, wireways, pullboxes, outlet boxes, etc.) shall comply with applicable requirements of Division 26.

2.3 FLOOR MOUNT EQUIPMENT RACKS AND FRAMES

A. Universal EIA self-supporting EIA aluminum rack. 84" H. x 19" W. x 6" D.

B. EIA standard for 19" rack mounted equipment.

C. EIA standard 3" x 1.25" aluminum upright channels, .125" thick.

D. Heavy-duty assembly hardware

E. Base Angles: 3-1/2" x 6" x 3/8" thick (pair) for bolting to floor.

F. Top Cross Angles: 1-1/2" x 1-1/2" x 1/4" (pair) compatible with overhead cable tray.

G. Mounting holes both sides (front and rear) of upright channels.

H. Finish: Black Powder Coat Finish

I. Panel Mounting Holes: #12-24 rolled threads in 5/8" - 5/8" x 1/2" hole pattern meeting EIA/TIA-568 mounting space requirements.

J. One double-sided vented shelf (21" deep) in bottom for UPS equipment for each rack section.

K. Minimum of one (1) additional single-sided ventilated shelves for each rack section. Contractor shall coordinate with Owner prior to installation of system equipment to confirm equipment arrangement in equipment racks. If all shelves will not fit in equipment racks Contractor shall turn over shelves to Owner for future use.

L. Provide cable management devices (clamps, guides, supports, etc. as required to neatly dress/organize cables in and out of rack (or enclosure). With the exception of wire management devices specified below, devices shall be installed per requirements to be determined in the field. As a minimum, Contractor shall provide vertical (full rack height) cable management as shown on the drawings. Wire management fill rate shall not exceed 50% condition when all provided jacks are in use. Contractor shall provide wire management sized as necessary for the number of cables installed and for the type of installation (i.e. rack or cabinet).

M. Each equipment rack shall have one vertical wire manager installed on each side of the equipment rack. Multiple contiguously installed equipment racks shall have a vertical wire manager installed between the adjoining equipment racks.

N. When mounting in another enclosure or millwork, provide width, height, hardware, etc. as required for complete and coordinated installation.

O. Provide all panels as required to mount equipment, including panel for power strip.

P. Provide ground bus full height minus six (6) inches. Mount to back of equipment rack. Connect to Systems ground bus bar.

Q. Provide all brackets to mount non-rack mountable equipment such as termination blocker (where called for.)

R. Provide all hardware, supports, etc. as required to mount/house all equipment called for and/or shown at each location.

S. Provide additional shelves as required for each piece of equipment mounted in rack that requires a shelf.

T. Equipment rack shall be provided with isolation pad utilizing non-conductive washers.

U. Rack area to include two (2) 20 amp, 120V duplex receptacles, each connected to separate 20 amp, 120V dedicated circuit. Mount in bottom area of rack. Refer to power drawings.

V. Rack to include two (2) power strips. Power strip to plug into UPS power back-up system which will be plugged into power outlet provided within equipment rack.

W. Power Strips: Comply with UL 1363.

1. Rack mounting.

2. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
3. LED indicator lights for power and protection status.
4. LED indicator lights for reverse polarity and open outlet ground.
5. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
6. Cord connected with 15-foot (4.5-m) line cord.
7. Rocker-type on-off switch, illuminated when in on position.
8. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
9. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.

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

1. Basis of Design

a. Chatsworth or acceptable substitution

2.4 RACK AND FRAME EQUIPMENT

A. Network Electronics:

1. Provided and installed by Owner

B. Uninterruptible Power Supply (UPS)

1. Provided and installed by Owner

2.5 CABLE SUPPORT SYSTEM

A. UL listed and labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

B. Horizontal cables shall be suspended by pre-manufactured CAT 6 rated cable hangers in closets where J-hooks, ladder tray or rack management is not available. All supports shall be permanently attached to the structure using all-thread suspension, beam clamps, or wall mount to the structural metal or wooden members. The J-hooks shall feature a wide base loop with smooth curves to eliminate snag potential and cable deformation.

C. J-hooks are to be in accordance with the NEC, EIA/TIA requirements for structured cabling systems.

D. Project Performance Requirements

1. Cable support system J-hooks shall be provided in sizes of 1”, 1-5/16”, and 2” only. J-hooks larger than 2” shall not be acceptable.
2. J-Hooks for Voice/Data cabling shall be blue in color.
3. The use of non-metallic cable supports shall not be acceptable.
4. Cable supports shall be supported from structure only.

E. Manufacturers

1. Basis of Design

a. Erico Caddy CAT HP Series J-Hooks

2. Acceptable Substitution

a. B-Line BCH Series J-Hooks

2.6 HORIZONTAL COPPER CABLE

A. 100 Ohm, 23 gauge copper, four (4) pair, Category 6 "voice/data" copper unshielded twisted pair cable.

B. Technical

1. Minimum NEXT (dB): 41.3 dB
2. Minimum PSNEXT (dB): 39.3 dB
3. Minimum ELFEXT: 19.8 dB
4. Minimum PSELGEXT: 16.8 dB
5. Minimum ACR: 8.5 dB
6. Minimum PSACR: 6.5 dB
7. Minimum Return Loss: 17.3 dB
8. Maximum Delay Skew (ns): 45 ns

C. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6.

D. The cable shall have surface markings: Verified UL Category 6

E. Plenum rating: Cable shall be plenum rated and marked CMP or Plenum (UL). Cable may be non-plenum rated where installed in non-plenum spaces/areas.

F. The cable shall be certified by the manufacturer as meeting requirements for a 25 year structured cabling system warranty. The cable shall be approved by the manufacturer for use in a warranted system from the connectivity manufacturer (e.g. patch panels, outlets, etc.) installed as part of this project.

G. Manufacturers

1. Basis of Design
   a. Panduit PUR6Co4bU-UY (Riser)
   b. Panduit PUP6Co4bU-UY (Plenum)

2. Acceptable Substitutions

a. Siemon
b. Ortronics
c. Amp

2.7 COPPER PATCH PANELS

A. Configuration: UL Listed and labeled, Category 6, angled, modular RJ-45 non-keyed 8-position jacks.

B. Wire Plan: EIA/TIA T568B.

C. Active Pins: 1 through 8.

D. Number of Ports: Configurations as called for on drawings.

E. Each port/jack to have dust cover.

F. Technical

1. NEXT (dB) @ 250MHz: 46.0 dB minimum
2. Insertion Loss (dB) # 250 MHz: 0.32 dB maximum
3. FEXT (dB) @ 250 MHz: 35.1 dB minimum

G. Manufacturers

1. Basis of Design

a. Panduit Mini-Com #CPPL48WBLY 48 Port Category 6 patch Panels

2. Acceptable Subsitutions

a. Siemon
b. Ortronics
c. Amp

2.8 WORKSTATION OUTLETS

A. Install and configure as shown on the drawings.

B. Workstation outlets shall be provided with ANSI/TIA/EIA-568-B.2-1 Category 6, 8-position modular jacks (RJ45 type) utilizing T568A wiring for voice and data connections. Jacks shall be certified to operate at 1000 Mbps data speed with twisted pair horizontal cabling as verified by ETL or UL. Faceplates shall be capable of accommodating up to 6, 8-position modular jacks each.

C. Wall Outlets: Wall outlets shall consist of a single gang wall plate, office white in color, with quantity of jacks as shown on the drawings, and blank module inserts for all unused module locations.

1. Plastic Faceplate: High-impact plastic.

2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
3. Blank Modules: Office White in color
4. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

D. Wireless Access Point (AP) Outlets shall consist of the same materials as wall mounted outlets but shall be flush ceiling mounted and centered near the middle of the room where shown on drawings.

E. Modular Furniture Outlets: Furniture outlets shall consist of a modular furniture faceplate capable of housing up to four (4) 8-position modular connectors with quantity of jacks as shown on the drawings, and blank module inserts for all unused module locations.

F. House Wall Phone: Wall phone outlets shall consist of a SE630 type wall plate with one (1) Category 6 terminating in an 8-position modular jack.

G. 8-position Modular Jack: Shall be Category 6 jacks meeting or exceeding the following electrical, mechanical and performance specifications:

1. Electrical Specifications:

a. Insulation Resistance: 500 MΩ minimum
b. Dielectric withstand voltage 1000 VAC RMS, 60 Hz minimum, contact-to-contact and 1500 VAC RMS, 60 Hz minimum from any contact to exposed conductive surface
c. Contact Resistance: 20 mΩ maximum
d. Current Rating: 1.5 A at 68 °F (20 °C) per IEC Publication 512-3, Test 5b
e. ISO 9001 Certified Manufacturer
f. UL Verified for EIA/TIA electrical performance
g. Comply with FCC Part 68
h. Terminate jacks in TIA T568A pin assignment configuration.
i. Mechanical Performance:
j. Plug Insertion Life: 750 insertions
k. Contact Force: 3.5 oz (99.2 g) minimum using FCC Approved modular plug
l. Plug Retention Force: 30 lb (133 N) minimum between modular plug and jack
m. Temperature Range: -40 °F to 150 °F (-40 °C to 66 °C).

2. Channel Performance: Category 6 jacks shall be utilized in a channel configuration meeting or exceeding the following specifications at 250 MHz:

a. NEXT (dB): 46.0 dB
b. Insertion Loss (dB): 0.32 dB or less
c. FEXT (dB): 35.1 dB
d. Return Loss (dB): 16.0 dB

3. Contractor shall provide and install white jacks for voice circuits and orange for data. Each multi-jack outlet shall have one (1) voice jack.
4. Manufacturers

a. Basis of Design

1) Panduit CFPSL2IWY 2-Port, CFPSL4IWY 4-Port, and CFPSL6IWY 6-Port Faceplates with CJ688TGIW Jacks

b. Acceptable Substitutions

1) Siemon
2) Ortronics
3) Amp

2.9 COPPER PATCH CORDS

A. Provided and installed by Contractor.

1. Provided and install copper patch cords in quantities and lengths necessary to patch all installed patch panel jacks.
2. Provide and install one (1) patch cord of minimum six foot length for each workstation outlet installed. Patch cords shall be by the same manufacturer as the horizontal cable or copper patchpanels.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the requirements of Section 27 05 00.

3.2 PATHWAYS

A. Comply with requirements for pathwaysas specified herein. Drawings indicate general arrangement of pathways and fittings.

3.3 CABLES/WIRES

A. Use of plastic or nylon cable ties within Communications rooms is strictly prohibited. Velcro cable ties or Velcro wraps shall be used instead of cable ties in all rooms where Category 6 cable cable is terminated.

3.4 LABELS

A. Each jack on patch panels shall be identified with permanent machine generated labels, meeting the EIA/TIA 606 requirements and matching the OCPS numbering plan as shown on the faceplate. Labeling shall be permanent. Labeling shall be 12 point in size.

B. 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: 2
2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration, including optional identification requirements of this standard.

D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

3.5 IDENTIFICATION

A. Cable and Cable Jackets

1. Category 6 cable and Category 6 patch cords for data shall have a jacket that is purple in color.
2. Category 6 patch cords for voice shall have a jacket that is white in color.
3. Category 6 jacks (patch panels and workstation outlets) shall be purple in color.

B. Outlet and Patch Panel Jack Colors

1. Owner’s Computer Network: Orange
2. Voice: White
3. Building Systems: Blue
4. CCTV: Yellow

C. Workstation outlets shall be labeled as shown on the drawings.

3.6 TESTING

A. Test Equipment

1. Acceptable testing equipment: Subject to compliance with requirements:

a. Agilent (HP) Wirescope

b. Fluke

2. Test equipment shall be 100% Level III compliant with TIA/EIS 568.2-1 specifications for testing of CAT 6 cabling. No testers will be approved without meeting these requirements.
3. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel and link test configurations. Use of patch cords shall not be allowed.
4. The correct cable NVP shall be entered into test equipment to assure proper length and attenuation readings.

B. Cable

1. Category 6 Cable and Outlets

a. Test each cable, Workstation Outlet jack, and Patch Panel jack in accordance with requirements for UTP Cable. In addition, perform the following tests in accordance with TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

1) Wire map
2) Length (physical vs. electrical, and length requirements)
3) Attenuation
4) Insertion loss
5) Near-end crosstalk (NEXT) loss
6) Power sum near-end crosstalk (PSNEXT) loss
7) Equal-level far-end crosstalk (ELFEXT)
8) Power sum equal-level far-end crosstalk (PSELFEXT)
9) ACR
10) PSACR
11) Return loss.
12) Propagation delay
13) Delay skew

b. Testing shall include:

1) The “basic link” and “channel”.
2) 100% passive testing of the cable system.

C. Documentation of Tests, Measurements, and Adjustments Performed:

1. Provide system verification and acceptance documentation signed and dated by the Contractor at the completion of testing. Document the following:

a. List of personnel in attendance during testing including the name of the Technician who performed each individual test.
b. List of certified test equipment used with serial numbers
c. List date of last calibration for each piece of test equipment

d. Date of each test
e. List reference settings of test equipment used for tests
f. Cable NVP used for testing
g. Submit testing results in hard copy and native electronic format.

2. System verification and acceptance documentation shall be provided with the Contractor's request for Substantial Completion.

END OF SECTION 27 10 00

SECTION 27 51 00 - AUDIO AND VIDEO SYSTEMS

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Comply with the requirements of Section 27 05 00 “Common Work Results for Communications”.

B. In addition to the requirements of Section 27 05 00 comply with the following requirements:

1. Standards, Codes, References, And Regulatory Requirements

a. The equipment and installation shall comply with the current or applicable provisions of the following standards, codes, references, and regulatory requirements:

b. Sound System Engineering by Don & Carolyn Davis (2nd Edition, Published by Howard W. Sams & Co., Inc.)

1) UL 813 - Commercial Audio Equipment
2) UL 1410 - Television Receivers and High-Voltage Video Products
3) UL 1419 - Professional Video and Audio Equipment
4) UL 1492 - Audio-Video Products and Accessories
5) UL 1971 - Signaling Devices for the Hearing Impaired

1.2 DESCRIPTION OF SYSTEM:

A. Provide and install a complete empty raceway system for Owner furnished and installed Audio and Video Systems in Conference Rooms and other meeting spaces as shown on the drawings.

1.3 FUNCTIONS AND OBJECTIVES

A. Not used.

PART 2 - PRODUCTS

2.1 NOT USED.

PART 3 - EXECUTION

3.1 Comply with the requirements of Section 27 05 00.

END OF SECTION 27 51 00

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SECTION 27 58 00 – TV DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Comply with the requirements of Section 27 05 00 “Common Work Results for Communications”.

1.2 DESCRIPTION OF SYSTEM

A. Provide and install a complete and satisfactorily functioning system providing the following:

1. A complete and fully functional extension of the existing building HDTV Distribution system providing transmission of video and associated audio signals for individual channels. In general terms, the system shall utilize an incoming cable TV feed from the local Cable TV Company, shall process source signals as necessary and as shown in the drawings, and then distribute the combined signals through a distributed cable infrastructure to the various locations throughout the facility. Distributed signals shall be maintained through the use of distribution amplifiers, splitters, taps, and a cable system designed to provide an optimal signal level at each system outlet in the facility.

    a. The TV Distribution system shall employ a cabling system providing homerun cables from each outlet to the local serving system’s room or closet.
    b. Provide a video signal to each TV Distribution Outlet between 5 and 10 dbmV at the television input for all channels.
    c. The system bandwidth shall include all frequencies from the sub-band through the hyper-band (5 MHz to 750 MHz)

2. Provide and install broadband distribution amplifiers, with return channel option, in locations shown on the drawings as required to provide the proper signal levels to all system outlets.

B. All necessary hookup, installation, programming, and testing shall be by a factory trained and certified technician.

C. Contractor shall provide and install patch cords for the system as necessary for all equipment and outlets including Owner provided, Contractor installed equipment.

D. System to include but not be limited to:

1. Horizontal Raceway System
2. Horizontal Cabling System
3. TV Outlet Faceplates with “F” type connectors
4. Splitters

5. Directional Couplers

1.3 FUNCTIONS AND OBJECTIVES

A. The system shall provide for the reception and display of both black and white and color signals and associated audio at every outlet in the facility

B. The system shall:

1. Meet or exceed all requirements in FCC Rules Part 76.
2. Provide a minimum signal level of +5 dBmv at each outlet for EIA Channels 02 through 116 inclusive.

a. Actual transmitted channels may include both Cable TV channels as well as locally generated RF signals. The system shall be cable of transmitting all system signals within the 5 MHz to 750 MHz bandwidth.
b. The difference between any two adjacent outlets shall not exceed 2 dB. Isolation between any two outlets shall be better than 28 dB in the sub-band through the super-band range (7 MHz – 300 MHz). Isolation in the hyper-band (300 MHz to 750 MHz) shall be greater than 20 dB.

3. Be capable of transmitting sub-band (7 MHz to 49 MHz) to the head-end equipment from any outlet in the facility.
4. Be designed to provide a minimum of +15 dB at the input to each system amplifier (head-end or remote).
5. Be designed to provide a minimum of 43 dB carrier-to-noise ratio and –45 dB (0.5%) cross-modulation level at the output of the last amplifier in the distribution system.
6. Not exceed radiation levels promulgated by the FCC.

1.4 SPECIAL REQUIREMENTS

A. Not used.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General:

1. All pathways (conduit, raceways, wireways, pullboxes, outlet boxes, etc.) shall comply with applicable requirements of sections within Division 26 of these specifications.

B. Conduit. (Comply with Division 26 except as noted below).

1. Bushings: Provide insulated bushings on ends of all raceway. All metallic conduits shall have bonding bushings and be bonded to the Systems Ground Bus Bar with an insulated #6 AWG wire.
2. Pull Cords: Install pull cords in all raceway runs that are installed without cable.

3. Size:

   a. Minimum size shall be ¾".
   b. The Contractor shall size raceways in accordance with the National Electric Code unless noted otherwise.

C. Boxes:

1. All outlet boxes, junction boxes, pull boxes, etc. shall comply with applicable section of these specifications.
2. Boxes shall be sized as required by NEC for cables, conduit and/or device installed.

2.2 "SYSTEMS" AND "LOCAL" GROUND BUS

A. Bus to comply with applicable sections of these specifications.

2.3 TV'S and Mounting Brackets

A. To be provided and installed by the Owner.

2.4 ACTIVE DEVICES

A. Broadband Indoor Rack Mount Hybrid Distribution Amplifier:

1. The hybrid amplifier shall have 33 db of operational gain and still retain low distortion characteristics.
2. The amplifier shall have -30 db input and -30 db output test points. The amplifier shall have optional plug-in flat attenuators and/or plug-in cable equalizer pads.
3. The amplifier shall have the following minimum electrical specifications:

   a. Frequency Range: 40-750 Mhz
   b. Gain: 30 Db
   c. Flatness: +/- 1.0 Db
   d. Gain Control Range: 15 Db
   e. Slope Control Range: 10 Db
   f. Return Loss Input: 14 Db
   g. Return Loss Output: 14 Db
   h. Noise Figure: 9.0 Db
   i. Hum Mod: -65 Db
   j. Output Level: 44 Dbmv
   k. Ctb: -55 Db
   l. X-Mod: -58 Db
   m. 2nd Order Intermod: -68 Db

4. The amplifier shall be the Blonder-Tongue 75A-30P.

2.5 PASSIVE DEVICES

A. Radiation Proof Hybrid Splitters:

1. Splitters used in systems, which obtain their signals from a CATV feed, shall comply with FCC specifications concerning radiation shielding. Housings shall be sealed and weatherproofed. Splitters may be two, four, or eight port devices.
2. Specifications:

    a. 2 Port

        1) Bandwidth: 5 – 750 MHz
        2) Thruloss (Max): 3.5 dB (5-500 MHz); 4.5 dB (600-750 MHz)
        3) Isolation (Min.): 27 dB
        4) Return Loss: 17 dB
        5) Radiation Shielding: >-80 dB

    b. 4 Port

        1) Bandwidth: 5 – 750 MHz
        2) Thruloss (Max): 7.2 dB (5-500 MHz); 8.5 dB (600-750 MHz)
        3) Isolation (Min.): 27 dB
        4) Return Loss: 18 dB
        5) Radiation Shielding: >-80 dB

    c. 8 Port

        1) Bandwidth: 5 – 750 MHz
        2) Thruloss (Max): 12.0 dB (5-500 MHz); 14.0 dB (600-750 MHz)
        3) Isolation (Min.): 27 dB
        4) Return Loss: 14 dB
        5) Radiation Shielding: >-80 dB

3. Manufacturers

    a. Basis of Design

        1) Blonder-Tongue SRT Series Splitters.

    b. Acceptable Substitution

        1) Pico Macom

B. Radiation Proof Directional Couplers:

1. Directional couplers used in systems which obtain their signals from a CATV feed shall comply with FCC specifications concerning radiation shielding. Housings shall be sealed and weatherproofed.
2. Specifications:

    a. Frequency Range: 5 - 1000 MHz
    b. Tap Values: 4-6-9-12-16-20-24-27 and 30 dB
    c. Thruloss: 3.5 - 0.5 dB dependent upon tap value
    d. Isolation: 18 - 40 dB dependent upon tap value

e. Input Return Loss: 12 - 18 dB dependent upon tap value
f. Tap Down Loss: 3 - 30 dB dependent upon tap value
g. Radiation Shielding: > -80 dB

3. Manufacturers

a. Basis of Design

1) Blonder-Tongue model CRT Series

b. Acceptable Substitution

1) Pico Macom

2.6 OUTLETS

A. Wall Taps

1. Taps shall be capable of mounting in a standard electrical wall outlet box.
2. Stainless steel, feed thru and self-terminating.
3. Outlets to have ‘G’ connector for television distribution system.
4. Manufacturers

a. Basis of Design

1) Blonder-Tongue Versa-Tap V-ST (3184) Self-Terminating

b. Acceptable Substitution

1) Pico Macom

B. Jumper Cable

1. Contractor/Installer shall provide one fabricated jumper cable for each outlet to the following specification. Transformer not required for cable-ready TV's.
2. Receiving Outlets -- length 8 ft.
3. Cable: Type RG/6.
4. Connectors: Two "F" male connectors; Blonder-Tongue #BTF-56 Hex
5. Transformer: 75 to 300 ohm; Blonder Tongue #4005
6. Provide one (1) jumper cable and one transformer at each TV outlet.
7. Manufacturers

a. Basis of Design

1) Blonder-Tongue

b. Acceptable Substitution

1) Pico Macom

2.7 WIRE AND CABLE

A. General

1. All cables shall be 100% factory swept tested to 1GHz. Certification shall be available for each reel.
2. If cable is used in a plenum environment it shall be UL listed for plenum application.
3. All underground or below slab cable runs shall be of the flooded type.

B. Drop Cable

1. Non-Plenum

a. RG6 Series Coaxial Cable
b. NEC Type: CATV CM
c. Conductor Type & Nom. DCR: 18 AWG (Solid) BC 6.5 Ohm/M'
d. Insulation Type and Thickness: Gas Injected PE; .180 inches
e. Shielding & % Coverage: Bifoil 100% and Alum. Braid 65%
f. Jacket Type: PVC
g. Nominal Capacitance: 16.2 pf/ft.
h. Nominal VP: 82%
i. Nominal Impedance: 75 Ohms
j. Jacket Color: Black
k. Manufacturers

1) Basis of Design

a) West Penn #841

2) Acceptable Substitutions

a) Belden
b) Commscope

2. Plenum

a. RG6 Series Coaxial Cable
b. NEC Type: CATVP CMP
c. Conductor Type & Nom. DCR: 18 AWG (Solid) BC 6.5 Ohm/M'
d. Insulation Type and Thickness: Foam FEP; .170 inches
e. Shielding & % Coverage: Bifoil 100% and Alum. Braid 77%
f. Jacket Type: Flexible Plenum
g. Nominal Capacitance: 16.2 pf/ft.
h. Nominal VP: 82%
i. Nominal Impedance: 75 Ohms
j. Jacket Color: Ivory
k. Manufacturers

1) Basis of Design

a) West Penn #25841

2) Acceptable Substitutions

a) Belden
b) Commscope

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. The Contractor is advised that circuit routing for this system is not necessarily shown on the project drawings.

   a. The Contractor shall provide and install all raceways, wiring and cabling required for a complete and fully functional system as intended by these specifications.
   b. The Contractor shall provide and install a properly sized, flush mounted outlet box for every device.
   c. The Contractor shall size and route raceways to accommodate the proper installation of the system cabling. T-Tapped cabling shall not be acceptable unless specifically required by the equipment manufacturer for proper operation of the equipment.
   d. In locations where raceway and/or conduit are not accessible after completion of the project, conduit shall be routed from device to device or fire rated access panels shall be installed to provide access to pull boxes. Routing of raceway from device to device shall only be acceptable where the wiring scheme of the system, as recommended by the manufacturer, requires cable to pass from device to device.
   e. Contractor shall properly terminate each device according to the manufacturer’s recommendations. Unless specifically noted otherwise, the Contractor shall provide and install cabling to connect all circuitry associated with a device.
   f. Provide and install firestopping where penetrations are made through rated walls and floors.

2. Install equipment in accordance with manufacturer's instructions.
3. Install equipment, cables, and raceways as required to comply with all applicable requirements of the references and/or regulatory requirements called for under PART 1 of this section of specifications, as a minimum installation requirement. Exceed this minimum requirement when called for herein.
4. Install all electrical basic materials per applicable sections of these specifications.
5. Install all rack mountable equipment in equipment cabinet.
6. All equipment, except portable equipment, shall be held firmly in place. (The exception shall be when the Contractor is required to use resilient shock mounting to decouple equipment from the structure it is being mounted to.
7. Fastenings and supports shall be adequate to support their loads with a safety factor of five (5).

8. All switches, connectors, outlets, etc., shall be clearly, logically, and permanently marked during installation. Where the equipment manufacturer does not provide markings or for fabricated and installed equipment the Contractor shall provide and install permanent, engraved labels for proper identification.
9. Install cabinets/racks in locations shown; arrange to provide adequate ventilation and access.
10. Properly ground system per applicable sections of these specifications.
11. Support raceways, backboards, and cabinets per applicable sections of these specifications and as recommended by the manufacturer.
12. Install raceways to conform to applicable sections of these specifications.
13. Install system wiring and/or raceways away from any surface that may become hot, including and not limited to, hot water piping and heating ducts.
14. Install system wiring with at least 12 inches of separation from line voltage power wiring on parallel runs. Wiring crossing power circuits shall be at right angles. For metal enclosed electric light or power or Class 1 circuits, separation may be reduced as described in the National Electric Code (NEC). Increase separation if so required to comply with referenced standards.
15. The majority of the system wiring will be installed above ceilings. All cabling used throughout this project shall comply with the requirements outlined in the National Electric Code (NEC) Article 760. All cabling shall bear CMP and/or appropriate markings for the environment in which they are installed.
16. Sealing of openings between floors, through rated fire and smoke walls, existing or created by the Contractor for cable pass through shall be the responsibility of the Contractor. Sealing material and application of this material shall be accomplished in such a manner which is acceptable to the fire and building authorities having jurisdiction over this work. Creation of such openings as are necessary for cable passage between locations as shown on the drawings shall be the responsibility of the Contractor's work. Any openings created by or for the Contractor and left unused shall also be sealed as part of this work.
17. The Contractor shall be responsible for any damage to any surfaces or work disrupted as a result of his work. Repair of surfaces, including painting, shall be included as necessary.
18. Maintain proper separation between system cables and all power and/or unshielded cables, as required to prevent noise, crosstalk, etc.
19. Each system outlet shall have splice-free cables homerun to its respective equipment as indicated on the drawings.

B. Equipment Racks/Cabinets:

1. Where multiple enclosures are configured as one continuous enclosure, they shall be installed with six inches (6") of clearance from any other structure to ensure adequate airflow for circulation fans.
2. In installations where it is not possible to maintain six inches (6") of clearance from a structure, or where specifically noted in the drawings and specifications, the Contractor shall provide a fan assembly to provide adequate airflow to the satisfaction of the Designer.

C. Outlets

1. Contractor shall provide and install an outlet plate with appropriate connectors for every device whether or not shown on the drawings.
2. Install devices/inserts in outlets so that same orientation is used throughout project.
3. Install per applicable section of these specifications (i.e., outlet boxes, indoor service poles, floor boxes, etc.).
4. Install wall plates with all inserts required to properly connect all equipment circuits and complete the installation in a professional manner.

D. Pathway

1. General

a. Raceway system shall meet the applicable requirements of all Division 26 sections.
b. Raceway system shall not be shared by power or any other electrical wiring that is not part of the system.
c. Bend raceway with minimum inside radius of 6 times the internal diameter. Increase bend radius to 10 times for raceway larger than 2 inch size. Provide proper bend for all changes of direction. Pull and splice boxes shall not be used in lieu of a bend.
d. Install raceways so no more than two 90^{o} bends are in any raceway section without a pullbox. Install additional pullboxes as required to maintain maximum of two 90^{o} bends between pullboxes and/or termination points.
e. Install raceways so no more than one hundred (100) feet of raceway are in any raceway section without a pullbox. Install additional pullboxes as required to maintain maximum of one hundred (100) feet between pullboxes and/or termination points.
f. Label all raceways at both ends to indicate destination and source. Also indicate length of raceway. This labeling/identification shall be fully documented in as-built (record) drawings.
g. Install polyethylene pulling string in each empty conduit over 10 feet in length or containing a bend.
h. Properly support cables/wire not installed in raceways.
i. Special Raceway Systems: Special raceway systems may be specified for some portions of the system. Refer to the drawings and other sections of these specifications to determine where or if such systems are used.
j. Fire Stop

1) Where conduit penetrates a fire rated wall, floor, etc., firestopping shall be provided.
2) Provide permanent firestopping seals after cable Installers have pulled risers and distribution cables.
3) Meet all requirements for UL assembly involved. Provide firestopping UL listed for assembly, conduit, and/or cable involved.

E. Grounding

1. Provide and install complete grounding system as required to comply with all sections of these specifications and applicable codes.
2. Connect equipment cabinets to "systems" ground bus with #6 green insulated copper ground wire.
3. Connect metal conduit (via grounding bushing) to "systems" ground bus.
4. Connect cable shields to "systems" ground busbar.
5. Connect surge suppression equipment to "systems" ground busbar.
6. The Contractor shall take such precautions as are necessary to guard against electromagnetic and electrostatic hum, and to install all equipment so as to provide maximum safety to the person who operates it.

F. Cables/Wires

1. Install cables/wires in accordance with manufacturer's instructions.
2. All cables shall be installed as illustrated on the drawings except where necessary to avoid EMI sources or other obstacles. Major deviations from the illustrated path must be accepted in advance by the Designer.
3. Cables shall not be spliced.
4. Provide adequate cable size and length for each run.
5. Install system cables no closer than 12" from any wire/cable installed for power system cable/raceway or fluorescent/ballasted light fixtures.
6. Provide protection for exposed cables.
7. All joints and connections shall be made with rosin-core solder or with mechanical connectors accepted by the Designer.
8. All cabling used throughout this project shall comply with the requirements outlined in the National Electric Code (NEC) Article 760. All cabling shall bear CMP and/or appropriate markings for the environment in which they are installed.

G. Labels

1. All equipment, control, and system cabling shall be provided with permanent descriptive labels
2. The Contractor shall provide samples of labeling with his submittals for review by the Designer.
3. Equipment and cable labels shall be noted on the Contractor’s as-built drawings exactly as they are installed on the equipment or cables.
4. Equipment

    a. The Contractor shall provide and install permanent, engraved labels on all equipment where the original manufacturer has not already provided labels.
    b. All custom, fabricated, or field assembled assemblies and equipment shall be provided with permanent engraved or non-removable silk-screened labels. The Contractor shall provide samples of labels to Designer for review and approval prior to fabrication or final installation. The Contractor shall modify labeling as required by the Designer.

5. Cables

a. The Contractor shall provide and install a permanent, machine printed, protected label on both ends of each system cable. The label at each end of the cable shall provide the following information:

1) System identifier
2) Room number where other end of cable is terminated

a) Where system cables are routed between buildings the Contractor shall preface the Room Number with a Building Number
b) Room numbers shall coincide with numbering scheme included in contract documents.

3) Device identifier where other end of cable is terminated

a) Device identifier shall provide a clear indication of device connected to.

3.2 SYSTEM TESTING

A. General

1. Provide all required testing apparatus necessary to successfully complete the system testing.
2. Provide factory trained personnel to perform the tests and adjust the system.
3. Kits, home-built, and other nonprofessional test equipment shall not be acceptable.
4. Documentation of Tests, Measurements, and Adjustments Performed:

a. List of personnel and certified test equipment used.
b. Impedance of all circuits.
c. The documented information for all settings of all active equipment.

5. Test all cables for shorts, opens, and grounds. Record results.
6. Accomplish full operational test of the system to verify all system programming is correct and functions as intended.

3.3 FIELD QUALITY CONTROL

A. Perform all testing where necessary or specified to assure a fully functional system. Replace and/or repair and retest components that fail performance standards.

B. Test all cables/outlets.

C. System verification and acceptance documentation signed and dated by the Contractor shall be provided. This documentation shall include test measurements and system calibrations performed for the entire system. Sample system operations shall also be performed with actual hardware or using Contractor provided test equipment and documented to verify that the system is operational and ready for acceptance. This shall also establish the baseline performance of the system.

D. System Commissioning:

1. Upon completion of the aforementioned tests and before system commissioning, testing shall be performed. The tests shall be performed with the system equipment and using Contractor provided test equipment. The tests shall be witnessed by the Designer.

END OF SECTION 16758

SECTION 28 31 00 – FIRE ALARM SYSTEM (EXTENSION OF EXISTING)

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Comply with the requirements of Section 27 05 00 “Common Work Results for Communications”.

B. Comply with applicable requirements of Division 23.

C. In addition to the requirements of 27 05 00 comply with the following requirements:

1. Related Sections

a. Standards, Codes, References, And Regulatory Requirements

1) The system shall have proper listing and/or approval from the following nationally recognized agencies:

a) UL Underwriters Laboratories Inc
b) ULC Underwriters Laboratories Canada
c) MEA Material Equipment Acceptance (NYC)
d) FM Factory Mutual
e) CSFM California State Fire Marshal

b. The equipment and installation shall comply with the current or applicable provisions of the following standards, codes, references, and regulatory requirements:

1) NFPA

a) NFPA 13 – Standard for the installation of Sprinkler Systems
b) NFPA 72 – National Fire Alarm Code
c) NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems
d) NFPA 101 – Safety to Life from Fire in Buildings and Structures

2) UL

a) UL 13 – Power-Limited Circuit Cables
b) UL 38 – Manual Signaling Boxes for Fire Alarm Systems
c) UL 217 – Single and Multiple Station Smoke Alarms
d) UL 268 – Smoke Detectors for Fire Protective Signaling Systems
e) UL 268A – Smoke Detectors for Duct Application
f) UL 521 – Heat Detectors for Fire Protective Signaling Systems
g) UL 539 – Single and Multiple Station Heat Detectors

h) UL 864 – Control Units for Fire Protective Signaling Systems
i) UL 1424 – Cables for Power-Limited Fire Alarm Circuits
j) UL 1425 – Cables for Non-Power-Limited Fire-Alarm Circuits
k) UL 1480 – Speakers for Fire Protective Signaling Systems
l) UL 1481 – Power Supplies for Fire Protective Signaling Systems
m) UL 1711 – Amplifiers for Fire Protective Signaling Systems
n) UL 1971 - Signaling Devices for the Hearing Impaired

3) Local and State Building Codes

a) Florida Building Code: 2010 edition with all revisions
b) Florida Administrative Code. All applicable chapters including but not limited to:

(1) Chapter 69A Rules, including but not limited to:

i. Ch 69A-3 Fire Prevention - General Provisions.
ii. Ch 69A-46 Fire Protection System Contractors and Systems.
iii. Ch 69A-47 Uniform Fire Safety Standards for Elevators.
iv. Ch 69A-48 Fire Safety Standards for the Fire Alarm Systems.
v. Ch 69A-60 Florida Fire Prevention Code

c) Florida Fire Prevention Code
d) Florida Department of Insurance:

(1) Insurance Code: The fire alarm system and installation thereof shall comply with the State of Florida Department of Insurance rules. The requirements of the Florida State Department of Insurance shall be as promulgated by the Division of State Fire Marshal.
(2) Fire Alarm Rules: The fire alarm system and installation thereof shall comply with the Fire Safety Rules promulgated by the Florida State Fire Marshal.

e) Authority Having Jurisdiction:

(1) General: The system shall comply with all applicable Codes, Ordinances and Standards as interpreted and enforced by the local authority having jurisdiction.
(2) Fire Department: Orange County Fire Department
(3) Building Official: Orange County Building Department
(4) State of Florida: Division of State Fire Marshal.

4) Surge Suppression

a) Equipment Certification: When available by any one manufacturer, all surge suppression equipment shall be listed by Underwriters' Laboratories, shall bear the UL seal and be marked in accordance with referenced standard. Such surge suppression equipment shall be UL listed and labeled for intended use.
b) Comply with all standards and guides as listed under "References" above.

2. Quality Assurance

a. Installer:

1) The Installer shall be currently licensed by the Electrical Contractors' Licensing Board as a Statewide Alarm Contractor I (EF).
2) The Installer's Field Supervisor shall be currently certified by the National Institute for Certification in Engineering Technologies as a NICET Level III or Level IV. NICET Level I or Level II shall not be acceptable.

b. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum ten (10) years experience and with service facilities within 50 miles of Project.
c. Installer:

1) Company specializing in installing the products specified in this section with minimum ten (10) years experience.
2) The Installer shall be currently licensed by the Electrical Contractors' Licensing Board as a Certified Alarm System Contractor I (EF).
3) The installing Contractor shall be a direct sales division of, or the authorized and designated distributor for, a fire alarm system manufacturer.
4) Installing Contractor shall maintain a local staff of specialists, including a Fire Alarm Planning Superintendent, for planning, installation, and service.
5) The installing Contractor shall maintain an office within fifty (50) miles of the project with capability to provide a 4-hour maximum response time and emergency service 7-days-a-week, 24 hour days. The installing Contractor shall have been actively engaged in the business of selling, installing and servicing fire alarm systems for at least ten (10) consecutive years going back from date of bid.

3. Submittals

a. Each system power supply including stand alone booster supplies
b. Each standby battery bank
c. Each notification appliance circuit
d. Each auxiliary control circuit that draws power from a system power supply.

1) Submit all load calculations and cable/wire sizing for each branch of the individual fire alarm field circuits. Wire sizing calculations to prove maximum three percent (3%) voltage drop at all AC voltages and maximum eight percent (8%) voltage drop at all DC voltages.

4. Maintenance Service

a. Furnish service and maintenance of fire alarm system for one (1) year from date of Substantial Completion.
b. No charge shall be made by the installer and/or contractor for any labor, equipment, or transportation during this period to maintain functions.
c. Respond to trouble call within twenty-four (24) hours after receipt of such call.
d. Provide annual testing and inspection of fire alarm system at end of first year in accordance with NFPA 72. Correct any deficiencies found at no cost to the Owner. Affix fire alarm tag to panel.

5. Spare Capacity

a. Contractor shall provide and install system equipment and materials in quantities that will provide the Owner with twenty percent (20%) spare capacity (e.g. termination points, jacks, ports, etc.) after connection of all circuits as required by the contract documents. Equipment and materials where spare capacity shall be provided include:

1) System Power Supplies
2) Audio Amplifiers

1.2 DESCRIPTION OF SYSTEM:

A. Provide and install a complete and satisfactorily functioning, code compliant extension of the existing system configured for the specific environment in which it is installed and as shown on the drawings.

B. The Contractor shall furnish and install a complete Addressable Analog Fire Detection System. The system shall include but not be limited to:
1. Combination Audible/Visual
2. Visual devices
3. Remote power supplies (Remote power supplies shall be in a UL Listed assembly and be provided by the same manufacturer as the Fire Alarm Control Panel (FACP)).
4. Programming.
5. Grounding
6. Wire and cable labeling.
7. Electrical power required to comply with all functions and operations called for in this section of the specifications. Contractor shall provide and install all 120 VAC circuits as required.
8. Conduit, wire, wire fittings, terminal cabinets with plywood and terminal strips, and all accessories required to provide a complete operating system.

9. A complete and accurate schematic/drawing of the fire alarm system to be placed adjacent to the fire alarm annunciator panel and the main fire alarm panel.

C. Unless specifically noted otherwise, Fire Alarm System equipment shall be the product of a single manufacturer.

D. System shall operate as a non-coded, continuous ringing system which will sound all audible devices and activate all visual devices until it is manually silenced.

E. System shall be wired as a Class B system for all circuits.

F. System is to be a complete analog addressable system except for portables. Portables shall be wired as hard-wired circuits.

G. Conduit and boxes to be installed by electrical contractor.

H. Fire alarm system shall not share a raceway, junction box, enclosure, manhole or device with any other system

1.3 SPECIAL REQUIREMENTS

A. The existing Fire Alarm Control Panel, Fire Alarm Power Supplies, Terminal Cabinet, and associated materials located in Electrical Room (127) on the first floor of the building are being moved in conjunction with the wall to which that equipment is currently mounted. The Contractor shall be responsible for removal and reinstallation of the existing equipment as necessary. It shall also be the Contractor's responsibility to maintain the building Fire Alarm system in an active, normal state at all times during construction and, in the event that the system is taken off line for more than four hours, to notify the Authority Having Jurisdiction and set a fire watch for the duration of the time the system is off line. Costs associated with setting a fire watch shall be included in the Contractor's bid for the project. Any damage to the existing equipment during construction shall be the Contractor's sole responsibility.

B. The Contractor shall, as part of his submittals, provide updated battery calculations for the existing system power supplies that take into consideration the existing circuits (outside the scope of work for this project) and the modified circuits (included in the scope of work for this project) to verify the existing batteries are adequate. If the battery calculations show that one or more battery banks will, at the end of this project, not meet the specified requirements the Contractor shall either upgrade the battery bank(s) in question or add an additional power supply with battery backup that meets the specified requirements.

1.4 FUNCTIONS AND OBJECTIVES

A. System Operation

1. System operation shall meet the operation requirements of all codes and regulatory requirements.

2. Upon activation of the Fire Alarm System by a manual station, smoke detector, or any other new or existing automatic device the following shall take place:

    a. Energize all alarm signaling devices.
    b. Sound all audible alarms and flash visual signals throughout the campus.
    c. Alert proprietary system.
    d. Cause alarm to be displayed on the annunciator section of the control panel.
    e. Cause alarm to be displayed on remote annunciator
    f. Close all doors or fire shutters, held open by automatic release devices throughout the facility, (coordinate with architect and door hardware supplier, provide all electrical required).
    g. Unlock all electrically locked time-out room doors (coordinate with the architect and door hardware supplier, provide all electrical required).
    h. Shut down all air handlers, exhaust fans supplying or exhausting air, and fan terminal boxes (FTB).
    i. Shut all fire and/or smoke dampers in ducts associated with the air handling units and exhaust fans which are shut down.
    j. Transmit signals to the building elevator control panel to initiate return to the main floor or alternate floor.
    k. Transmit signals to the building automation system to tell system that the fire alarm system has taken control of respective mechanical system.
    l. Send a signal to all dimming and lighting relay/control systems. Fire alarm signal shall initiate dimming system controls to drive all dimmed circuits to immediate full-on output. Fire alarm signal shall initiate lighting relay/control system to turn on all emergency lighting circuits.
    m. Send a signal to all non-fire alarm sound reinforcement systems. Fire alarm signals shall override all other sound systems. Alarm notification signals shall take precedence over all other signals. Operation of other sound systems shall resume after fire alarm system clears alarm.
    n. Activate the system dialer and transmit the signal to the monitoring contractor, to notify the local Fire Department.

3. System supervisory faults, such as shorts, opens, and grounds in conductors, operating power failure, or faults within supervised devices, shall place the system in the trouble mode, which causes the following system operations:

    a. Visual and audible trouble signal indicated by zone at the fire alarm control panel.
    b. Visual and audible trouble signal indicated at remote annunciator panel.
    c. Trouble signal transmitted to central station.
    d. Manual acknowledgement function at fire alarm control panel shall silence audible trouble signal; visual signal shall be displayed until initiating failure or circuit trouble is cleared.

4. Alarm Reset: The system shall remain in the alarm mode until manually reset with a key accessible reset function. The system shall reset only if the initiating circuits are cleared.
5. Lamp Test: manual lamp test function causes alarm indication at each lamp on the fire alarm control panel and the remote annunciator.

6. When the fire alarm system is activated as a drill, all incidental functions shall be exercised including notification of the fire department.
7. Where required by codes or authority having jurisdiction:

    a. When system is silenced by silence switch in control panel, audible alarm is to silence but visual alarm devices are to continue to operate.

8. Fire sprinkler valve tamper switch, when closed, shall annunciate a supervision signal at the fire alarm control panel and annunciator panels, if any. This supervision signal shall not cause a general alarm.
9. Operation of auxiliary contacts in control panel to shut all smoke dampers in ducts associated with air handling units and exhaust fans which are shut down. (These shall not be controlled from detector unit contacts.)

B. Zoning

1. Alarm Zones.

    a. Regardless of the number of zones shown on drawings, the minimum alarm zones required are:

        1) One per building, per floor for pull stations.
        2) One per building, per floor for automatic devices.
        3) One for each duct smoke detector).
        4) Each device shall be individually annunciated/addressable.

2. Notification Zones.

    a. Regardless of the number of zones shown on drawings the minimum notification zones (horns and strobe lights) required are:

        1) One (or more) circuit(s) for administration building
        2) One (or more) circuit(s) for exterior horns
        3) One (or more) circuit(s) for remainder of campus.

    b. Breakdown circuits as required for load and distances involved.

PART 2 - PRODUCTS

2.1 FIRE ALARM CONTROL PANEL:

A. All equipment and materials installed as part of this project shall be fully compatible with the existing FACP.

2.2 FIRE ALARM SYSTEM COMPONENTS:

A. Audible Notification Devices:

1. Shall be horn type devices.

2. Audible notification devices located on the exterior of a building, or in a damp or wet location, shall be a weatherproof version and rated, by the manufacturer, for use in wet locations.
3. Audible portion of the audible/visual notification devices shall be UL listed for fire protective service and shall provide 24 VDC inputs and sound output of not less than 75 dBA at 10 feet, or more than 120 dBA at the minimum hearing distance from the audible appliance.
4. Audible portion of the audible/visual notification device shall compliant with ANSI S3.41 for signal character conformance.
5. Audible portion of audible/visual notification devices located on the exterior of a building, or in a damp or wet location, shall be a weatherproof version and rated, by the manufacturer, for use in wet locations.
6. A suitable polycarbonate cover shall be provided to protect devices at locations where they may be subject to damage.

B. Visual Notification Devices

1. Shall meet the requirements of the ADA, UL Standard 1971 and shall meet the following criteria:

    a. The maximum pulse duration shall be 2/10 of one second.
    b. Strobe intensity shall meet the requirements of UL 1971.
    c. The flash rate shall meet the requirements of UL 1971.

2. Visual portion of the audible/visual notification devices shall comply with the Americans with Disabilities Act which includes the following:

    a. Lamp shall be a xenon strobe type or equivalent.
    b. Color shall be clear or nominal white (i.e. unfiltered or clear filtered white light).
    c. Maximum pulse duration shall be two-tenths of one second (0.2 sec) with a maximum duty cycle of 40 percent. Pulse duration is defined as the time interval between initial and final points of 10 percent of maximum signal.
    d. Intensity shall be a minimum of 75 candela. Use of visual devices rated at 15/75, 15 or 30 candela shall not be acceptable.
    e. Flash rate shall be a minimum of 1 Hz and a maximum of 3 Hz.
    f. More than two visible notification appliances in the same room or adjacent space within the field of view must flash in synchronization. This requirement shall not preclude synchronization of appliances that are not within the same field of view.

3. A suitable polycarbonate cover shall be provided to protect devices at locations where they may be subject to damage such as Gymnasiums.

C. Manufacturers

1. Basis of Design

    a. Farenhyte IFP2000 (no substitutions allowed)

2.3 FIRE ALARM SYSTEM COMPONENTS – ADDRESSABLE DEVICES:

A. Addressable Devices – General

1. Addressable devices shall use simple to install and maintain decade, numbered 0 to 9, address switches. Detectors that have expanded addressing will have decade switch numbered from 0 to 15 for the most significant digit to allow detector addressing from 1 to 159.
2. Addressable devices which use a binary-coded address setting method, such as a DIP switch, are not an allowable substitute.
3. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel signaling line circuits.
4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity shall be automatically adjusted by the panel on a time-of-day basis.
6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.
8. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
11. Detectors shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LEDs shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
12. Addressable devices shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel

shall use to identify the type of device. LED(s) shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.

13. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

B. Intelligent Photoelectric Smoke Detector

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

C. Manufacturers

1. Basis of Design

a. Farenhyte (no substitutions allowed)

2.4 FIRE ALARM SYSTEM BATTERIES:

A. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.

B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

C. If necessary to meet standby requirements, external battery and charger systems may be used.

2.5 PATHWAYS:

A. Comply with the requirements of Section 27 05 00.

2.6 CABLE:

A. Contractor shall provide and install cable as required by the manufacturer to provide a complete, fully operational, UL Listed Fire Alarm system.

B. Fire alarm system cables installed in interior, exterior and/or underground raceways shall comply with the applicable sections of NEC Articles 760, 770 and 800.

C. Cables shall be for power-limited fire alarm signal service Type FPL, and NRTL listed and labeled as complying with NFPA 70 Article 760, UL 1424 and UL 2196. Where installed in return air plenums cable shall be plenum rated. All vertical Fire Alarm cables and wiring traversing more than one level shall be routed in rated enclosures. In addition, all horizontal wiring serving devices located on floors other than where wiring originates shall be routed in 2-inch concrete encasement, suitable rated building construction, or 2-hour wrap application enclosure accepted by local authority having jurisdiction.

D. Zip and zip type cables (e.g. West Penn 970, 971, 972, 974 or similarly constructed cables from other manufacturers) shall not be acceptable.

E. Conductor: 98% conductivity, stranded copper with maximum of 19 strands. Stranded conductors shall have a compression lug installed at every end. Wrapping twisted strands at terminal block screw is not acceptable. As an acceptable equivalent, stranded conductors without crimp-on lugs may be terminated into terminal strips of box-lug connectors. SLC loops may use solid conductors.

F. Insulation: A type accepted by NEC for the application. All cable shall be UL listed for fire-protective signaling application. Communication, Class 3 or Multi-Purpose cables shall not be substituted for FP cable types. All multiconductor cables shall have individually insulated conductors with an overall outer jacket.

G. Size: All conductors shall be sized as prescribed by the system manufacturer, with following minimums:

1. Multiplex Signaling Line Circuit: AWG #16, solid.
2. Notification Circuits, Devices: AWG #14, THHN/THWN stranded conductors.
3. Initiating Circuits, Hard-Wired Devices: AWG #14, THHN/THWN stranded conductors.
4. Initiating Circuits, Addressable Devices: AWG #14, shielded twisted pair.
5. The above wire sizes shall be increased to size as required to comply with authority having jurisdiction or as required for voltage drop, load, etc. Provide larger conductors where required to maintain voltage drop or signal strength within acceptable limits.
6. Multiplex signal line circuits and addressable circuits shall be either shielded or unshielded based on equipment manufacturer’s recommendations for specific application.

H. UL:

1. General: Fire-protective signaling cable shall be UL listed as non-power limited or power limited as needed to match the output of the fire alarm equipment.
2. Non-Power Limited: Fire protective signaling circuits classified as non-power limited shall use cable listed under UL Electrical Construction Materials Directory. Category HNHT, "NON-POWER LIMITED FIRE-PROTECTIVE SIGNALING CABLE". all such cable shall have fire resistance, listing and markings as described in NEC 760. Minimum cable marking shall be NPLF.
3. Power Limited: Fire protective signaling circuits classified as power limited shall use cable listed under UL Category HNIR, "POWER LIMITED FIRE-PROTECTIVE SIGNALING CABLE". All such circuits shall be durably marked where plainly visible at terminations to indicate that it is a power-limited fire protective signaling circuit. Refer to paragraph titled "Fire Resistance of Cables" for additional requirements.
4. Fire Resistance of Cables: Power-limited fire-protective signaling circuit cables shall be UL listed as described in NEC 760. All such cable shall bear a cable marking that includes a Type designation as given in NEC 760. Provide Type FPL.

I. Wiring color code shall be as follows:

1. Horns/Strobes: Black/Red
2. Door Holders: White
3. Air Handler Duct Detectors: Purple
4. Gas Shut-Off Pull Stations: Orange
5. Addressable: Twisted Pair Data Wire
6. Hard-Wired: Brown/Blue

J. Manufacturers

1. Basis of Design

a. Belden

2. Acceptable Substitutions

a. West Penn Wire
b. Draka

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the requirements of Section 27 05 00.

B. Pathways:

1. Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. The system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
2. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.

C. Contractor is advised that circuit routing for this system is not necessarily shown on the project drawings. The contractor shall provide and install all raceways, wiring and cabling required for a complete and fully functional system as intended by these specifications. Contractor shall provide and install a properly sized, flush mounted outlet box for every device. Contractor shall size and route raceways to accommodate the proper installation of the system cabling. T-Tapped cabling shall not be acceptable. In locations where raceway and/or conduit is not accessible after completion of the project, conduit shall be routed from device to device or fire rated access panels shall be installed to provide access to junction and pull boxes. Routing of raceway from device to device shall only be acceptable where the wiring scheme of the system, as recommended by the manufacturer, requires cable to pass from device to device. Contractor shall properly terminate each device according to the manufacturer’s recommendations.

D. Locate, install, and test fire alarm and detection systems in accordance with the equipment manufacturer's written instructions, and the latest editions of the National Electric Code, the National Electrical Contractor's Association publication "Standard of Installation" and all applicable codes and standards referenced in this specification.

E. Provide all work required for a complete system including complete system testing and checkout. All components shall be properly mounted and wired. The installation of this system shall comply with the directions and recommendations of authorized factory representatives.

F. Provide wiring, cabling, raceways, and electrical boxes in accordance with manufacturer's written instructions.

G. Components shall be electrically "burned-in" by operating the component at full power for a period as recommended by the manufacturer.

H. Installation shall be done in a neat workmanlike fashion by a firm regularly engaged in Fire Alarm Installation and Service.

I. The installation and inspection of all fire detection and fire alarm devices and systems shall be performed by, or under the direct on-site supervision of, a licensed fire alarm technician or a fire alarm planning superintendent who shall certify the work upon completion of the activity. The certifying licensee shall be present for the final test prior to certification.

J. As-built plans and wiring diagrams shall bear the signature and license number of the licensed fire alarm planning superintendent, the date of installation and the name, address, and certificate-of-registration number of the registered firm.

K. All components shall be completely wired. System shall be fully operable when main power service has failed and the Emergency Standby Generator has assumed emergency system loads. This shall require that any devices which required 120 volt power shall receive supply from an emergency 120 volt source.

L. Installation of detectors:

1. All ceiling mounted detectors shall be installed in accordance with the requirements of NFPA 72.
2. All concealed detectors shall be provided with a remote indicating lamp and test switch installed in an occupied space (corridor, etc.) on wall or on the ceiling grid indicating the type of detector and the zone to which it is connected. Label shall be red with white lettering.
3. Duct detectors shall be installed in accordance with NFPA 90A. All brackets and hardware shall be provided as required to install detector housing in correct position. All detector housings shall be sealed as required to prevent air leakage between duct and housing. Sampling tubes of proper length shall be provided and installed to match duct width at the installed location.

3.2 RACEWAYS AND BOXES

A. Comply with the requirements of Section 27 05 00.

B. Provide dedicated raceway with applicable boxes for all fire alarm wiring in accordance with applicable sections of these specifications.

C. All initiating, indicating and auxiliary control devices shall be mounted on UL listed outlet boxes.

D. Identify raceways and boxes per requirements of Division 26.

3.3 WIRE/CABLE

A. Comply with the requirements of Section 27 05 00.

B. Comply with NECA 1 and NFPA 72.

C. Connections of Installation Wiring:

1. Connections to Equipment: In accordance with NFPA for monitoring integrity and with the equipment manufacturer's instructions.
2. Connections of installation wiring to alarm initiating devices and alarm indicating appliances shall be monitored for integrity.
3. Interconnecting means shall be arranged so that a single break or single ground fault will not cause an alarm signal.
4. Apply a compression lug, similar to T&B Sta-Kon Terminal, to all stranded conductors at terminations or use box-lug terminal strips.
5. There shall be no wire splices. All wiring shall be continuous, uncut between devices and terminal blocks.
6. Install plenum cable in environmental air spaces, including plenum ceilings.
7. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
8. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
9. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is not permitted.
10. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for Initiating Device Circuits and Signaling Line Circuits, and 14 AWG (1.63 mm) for Notification Appliance Circuits.
11. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
12. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
13. Wiring used for the multiplex communication circuit SLC shall be twisted and shielded and support a minimum wiring distance of 10,000 feet. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit.

14. All field wiring shall be electrically supervised for open circuit and ground fault.

D. Rated Enclosures:

1. All vertical fire alarm wiring traversing more than one level shall be routed in rated enclosures. In addition, all horizontal wiring serving devices located on floors other than where wiring originates shall be routed in 2-inch concrete encasement, suitable rated building construction, or 2-hour wrap application enclosure accepted by local authority having jurisdiction.
2. Install wiring in a metal raceway system according to Division 26 Section "Raceway and Boxes for Electrical Systems."

   a. Wire and cable shall be installed in a complete raceway system.
3. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring.Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and cover red.Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

G. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.4 AUDIBLE SIGNAL DEVICES, VISUAL SIGNAL DEVICES OR COMBINATION AUDIBLE/VISUAL SIGNAL DEVICES

A. Shall comply with NFPA, the Americans with Disabilities Act and other applicable handicap/accessibility codes including but not limited to the following:

1. Wall mounted devices shall have their bottom edge at heights above the finished floor of not less than 80 inches and no greater than 96 inches.
2. In general, no place in any room or space required to have a visual signal appliance shall be more then 50 ft. (15 m) from the signal (in the horizontal plane). In large rooms and spaces exceeding 100 ft. (30 m) across, without obstructions 6 ft. (2 m) above the finished floor, such as auditoriums, devices may be placed around the perimeter, spaced a maximum 100 ft. (30 m) apart, in lieu of suspending appliances from the ceiling. Placement of visual devices shall not be less than the requirements as specified by NFPA 72.

3. No place in common corridors or hallways in which visual alarm signaling appliances are required shall be more than 50 ft. (15 m) from the signal. Placement of visual devices shall not be less than the requirements as specified by NFPA 72.
4. Audible device dB levels shall comply with NFPA 72 requirements and shall be a minimum of 15 dB above average ambient room noise or 5 dB above maximum room noise levels. The Contractor shall add devices as necessary to ensure dB levels per NFPA are met in all required spaces.

3.5 END-OF-LINE DEVICE

A. Mount end-of-line device box with last device or separate box adjacent to last device in circuit.

3.6 CABLE IDENTIFICATION

A. Provide and install permanent cable markers on all cables/wire lines, telephone lines, etc. at terminal strips, terminal cabinets and at main equipment.

3.7 CONDUIT/BOX IDENTIFICATION

A. Contractor shall identify fire alarm conduit and boxes with red paint in exposed locations. Identify conduit in concealed locations with 4" mark of red paint every 4'-0" O.C.

3.8 DEMONSTRATION

A. When system is complete it shall be demonstrated to Owner's Representative who shall be given complete instructions, spare parts, manuals and maintenance information.

3.9 TESTING

A. Comply with the requirements of Section 27 05 00.

B. The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72.

C. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

D. Open initiating device circuits and verify that the trouble signal actuates.

E. Open and short signaling line circuits and verify that the trouble signal actuates.

F. Open and short notification appliance circuits and verify that trouble signal actuates.

G. Ground all circuits and verify response of trouble signals.

H. Check presence and audibility of tone at all alarm notification devices.

I. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.

J. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

K. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.10 SYSTEM DEMONSTRATION

A. Prior to certification of the fire alarm system the contractor shall accomplish a complete test of the fire alarm system in accordance with NFPA 72, Test Methods.

B. Perform a complete, functional, component by component test of the entire fire alarm and detection system. Provide a detailed step by step testing procedure which is unique to this project, reflecting the type of system and the number and location of all components.

C. Perform a sensitivity test of all smoke detectors and duct detectors. Perform a calibration/test of heat sensors.

D. Demonstrate the proper operation of each component as follows:

1. Photoelectric, and duct smoke detectors: activate the detector with a "false smoke" product which has been specifically formulated for testing smoke detection systems.
2. Heat detectors: activate the detector by utilizing the detector check button.
3. Pull Stations: activate the station by operating the station in its normal mode.
4. Audible and Visual Alarms: verify proper operation when the system is put into the alarm mode.
5. Sprinkler Flow Switches: open the sprinkler system's inspection test valve. Verify that the flow switch sends an alarm signal within the allowed time corresponding to the switch's time delay setting.
6. Fire Alarm Panels: functionally check-out and test the panel per the manufacturer's written instructions. Demonstrate the proper operation of each modular component. Demonstrate automatic power change to batteries and back to building power upon a drop in voltage below the voltage threshold as specified by the panel manufacturer.
7. Demonstrate the supervisory function at each device loop circuit, and at all single component wiring runs such as for the sprinkler valve supervisory switches.

3.11 CERTIFICATION

A. After completion of the installation of the system, the licensee shall complete a NFPA Inspection and Testing form. The Inspection and Testing form format shall be as indicated in NFPA 72, Inspection and Testing Form. When an Inspection and Testing form has been completed, legible copies shall be distributed as directed by the Authority Having Jurisdiction.

B. After an installation has been complete, affix a Fire Alarm Tag to the control panel. The Fire Alarm Tag is in addition to the Inspection and Testing form. Protect the Fire Alarm Tag from vandalism by applying pressure sensitive label; do not use a "tie-on" tag. It shall be as required in the Fire Safety Rules.

C. After completion of the installation and testing provide NFPA 72 Record of Completion form to the Owner.

3.12 FINAL DRAWINGS

A. As-built drawings shall be given to the Owner’s representative, at time of instruction, in addition to those to be supplied as general requirements of the job.

3.13 AUTHORITY HAVING JURISDICTION

A. The drawings and specifications herein comply to the best of the Designer’s knowledge with all applicable codes at time of design. However, it is this contractor's responsibility to coordinate/verify (prior to bid) the requirements of the Authority Having Jurisdiction over this project and bring any discrepancies to the engineer's attention at least 7 days prior to bid. No changes in contract cost will be acceptable after the bid for work/equipment required to comply with the authority having jurisdiction.

END OF SECTION 28 31 00