

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

MIAMI UNIVERSITY OF OHIO
ERRCS PHASE 1 IMPLEMENTATION

Heapy Engineering
Mechanical Electrical Commissioning Technology
Dayton, Ohio Project No. 2016-91018

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MARCH, 2017

28 05 01 BASIC ELECTRONIC SAFETY AND SECURITY REQUIREMENTS

PART 1 - GENERAL

1.1 Special Note

- A. All provisions of the Bidding Requirements, General Conditions and Supplementary Conditions, including Division 00 and Division 01, apply to work specified in this Division.
- B. The scope of the Division 28 work includes furnishing, installing, testing and warranty of all work and complete Electronic Safety and Security systems as shown on the drawings and as specified in Division 28 and elsewhere in the project documents.
- C. Understanding that the contractors for various Divisions are sub-contractors to the Prime Contractor, assignments of work by division are not intended to restrict the Prime Contractor in assignment of work among the contractors to accommodate trade agreements and practices or the normal conduct of the construction work. If there is a conflict of assigned work between Divisions 02 thru 33 and Divisions 00 and 01, Divisions 00 and 01 shall take precedence.
- D. The project drawings and specifications define scope of work for the various divisions. Such assignments of work are not intended to restrict the Construction Manager in assignment of work among the contractors to accommodate trade agreements and practices or the normal conduct of the construction work. If there is a conflict of assigned work between Divisions 02 thru 33 and Divisions 00 and 01, Divisions 00 and 01 shall take precedence.

1.2 Bid Alternates

A. BASE BID

- 1. The base bid scope of work includes all work necessary to provide the work indicated at the Cole Services Building (CSB), Hughes Hall and Armstrong Student Center (ASC).

B. Alternate T-1 Western Campus Dorms WRA, WRB, WRC ADD ALTERNATE

- C. The base bid work does not include The ERRCS system in Western Campus Student Dorms Beechwood (WRB), Hillcrest (WRC), and Stonebridge (WRA).

- D. Each bidder is requested to state the addition in cost to provide all Electronic Safety and Security work for the ERRCS systems in the Western Dorms Beechwood (WRB), Hillcrest (WRC) and Stonebridge (WRA) including the fiber card in the headend at CSB which serves the Hillcrest fiber remote.

E. Alternate T-2 Farmer School of Business (FSB) ADD ALTERNATE

- F. The base bid work does not include The ERRCS system at Farmer School of Business (FSB).

- G. Each bidder is requested to state the addition in cost to provide all Electronic Safety and Security work for the ERRCS systems in FSB including the fiber card in the headend at CSB which serves the fiber remote.

H. Alternate T-3 Millett Hall (MIL) ADD ALTERNATE

- I. The base bid work does not include The ERRCS system at Millett Hall (MIL).

- J. Each bidder is requested to state the addition in cost to provide all Electronic Safety and Security work for the ERRCS systems in MIL including the fiber card in the headend at CSB which serves the fiber remote.

- K. Alternate T-4 North Parking Garage (NPG) ADD ALTERNATE
- L. The base bid work does not include The ERRCS system at the North Parking Garage (NPG).
- M. Each bidder is requested to state the addition in cost to provide all Electronic Safety and Security work for the ERRCS systems in NPG including the fiber card in the headend at CSB which serves the fiber remote.
- N. Refer to the description of Alternates in Division 01 which affect the Division 28 work.

1.3 Unit Prices

A. Unit price UP-1

1. Provide unit prices to furnish and install all items identified below:

- a. Fiber Line Card (at CSB) \$_____
- b. Fiber Remote Amp \$_____
- c. Indoor antenna, lay0in ceiling, with connector(installed) \$_____
- d. 1/2" hardline, 200' installed in existing cable tray \$_____
- e. 2" fire rated sleeve \$_____

1.4 Permits and Regulations

- A. Furnish for the Owner certificates of approval from the governing inspection agencies, as a condition for final payment.
- B. Work must conform to the National Electrical Code, National Electrical Safety Code and other applicable local, state and federal laws, ordinances and regulations. Where drawings or specifications exceed code requirements, the drawings and specifications shall govern. Install no work contrary to minimum legal standards.
- C. All electrical work shall be inspected and approved by the local jurisdictional authority.
- D. All electrical work shall be inspected and approved by the Ohio Division of Industrial Compliance who will issue the inspection certificate.
- E. Upon completion of work, the Contractor shall furnish to the consulting State Engineer the certificate of inspection and approval before final payment on contract will be allowed.
- F. Final acceptance of all work will also be subject to the approval of the University Physical Plant Department.

1.5 Inspection of Site

- A. Inspect the project site and the premises of the existing building. Conditions shall be compared with information shown on the drawings. Report immediately to the Engineer, any significant discrepancies which may be discovered. After the contract is signed, no allowance will be made for failure to have made a thorough inspection.

1.6 Drawings and Specifications

- A. The drawings indicate the general arrangement of the work and are to be followed insofar as possible.
 - 1. The word "provide", as used, shall mean "furnish and install".
 - 2. The phrase "shall support" shall mean that no additional time, material or labor is required to have the specified referenced feature/function/capability fully operational.
 - 3. If significant deviations from the layout are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted to the Engineer for approval before proceeding with the work.
- B. Make all necessary field measurements to ensure correct fitting. Coordinate work with all other trades in such a manner as to cause a minimum of conflict or delay.
- C. The drawings and specifications shall be carefully studied during the course of bidding and construction. Any errors, omissions or discrepancies encountered shall be referred immediately to the Engineer for interpretation or correction, so that misunderstandings at a later date may be avoided. The contract drawings are not intended to show every vertical or horizontal offset which may be necessary to complete the systems. Having wireways and fittings fabricated and delivered in advance of making actual measurements shall not be sufficient cause to avoid making offsets and minor changes as may be necessary to install wireways, fittings and equipment.
 - 1. Where there are quantity discrepancies of equipment shown on drawings and / or specifications, the Contractor shall provide the greater quantity.
- D. The Engineer shall reserve the right to make minor adjustment in locations of system runs and components where he considers such adjustments desirable in the interest of protecting and concealing work or presenting a better appearance where exposed. Any such changes shall be anticipated and requested sufficiently in advance as to not cause extra work, or unduly delay the work. Coordinate work in advance with all other trades and report immediately any difficulties which can be anticipated.
- E. Equipment, ductwork, piping and electronic safety and security wiring shall not be installed in the dedicated electrical space above or in the working space required around electrical switchgear, motor control centers or panelboards as identified by NEC 110.26 Spaces About Electrical Equipment – 600 Volts Nominal or Less. For equipment rated over 600 volts nominal – 110.32 Work Space about Equipment – 110.33 Entrance and Access to Work Space – 110.34 Work Space and Guarding. Caution other trades to comply with this stipulation.
- F. Where any system runs and components are so placed as to cause or contribute to a conflict, it shall be readjusted at the expense of the contractor causing such conflict. The Engineer's decision shall be final in regard to the arrangement of conduit, etc., where conflict arises.
- G. Provide offsets in system runs, additional fittings, necessary conduit, pull boxes, conductors, switches and devices required to complete the installation, or for the proper operation of the system. Exercise due and particular caution to determine that all parts of the work are made quickly and easily accessible.
- H. Should overlap of work among the trades become evident, this shall be called to the attention of the Engineer. In such event, none of the trades or their suppliers shall assume that he is relieved of the work which is specified under his branch until instructions in writing are received from the Engineer.

1.7 Asbestos Materials

- A. Abatement, removal or encapsulation of existing materials containing asbestos is not included in the Division 28 Contract. Necessary work of this nature will be arranged by the Owner to be done outside of this construction and remodeling project by a company regularly engaged in asbestos abatement. Such work will be scheduled and performed in advance of work in the construction and remodeling project.
- B. If, in the performance of the work, materials are observed which are suspected to contain asbestos, the Contractor shall immediately inform the Engineer who in turn will notify the Owner. Work that would expose workers to the inhalation of asbestos particles shall be terminated. Work may be resumed only after a determination has been made and unsafe materials have been removed or encapsulated and the area declared safe.

1.8 Coordination Drawings

- A. The Division 23 Contractor shall prepare and be responsible for 0.25inch scale electronic coordination drawings. These drawings shall be produced using a computer aided drafting software of a mutually agreed upon format with the Division 21, 22, 23, 26, 27 and 28 Contractors. Each Contractor shall prepare their own electronic drawings, using common backgrounds obtained from the Engineer and Structural Engineer. The Division 23 Contractor shall be responsible for consolidating (merging) the drawings into combined coordination drawings, and lead the conflict resolution process, with all contractors working together to obtain finished coordinated drawings. No work shall be installed until all contractors have approved and signed-off with their approval and drawings have been submitted and reviewed by the Engineer.
- B. Review by the Engineer is cursory. It is the Contractors responsibilities to ensure that all work is coordinated, including fit above ceilings and that specified ceiling heights are maintained.

1.9 Inspection

- A. All work shall be subject to inspection of Federal, State and local agencies as may be appropriate, and of the Engineer and Engineer.
- B. Obtain final inspection certificates and turn over to the Owner.

1.10 Record Drawings

- A. Maintain a separate set of field prints of the contract documents and show all changes or variations, in a manner to be clearly discernible, which are made during construction. Upon completion of the work and within 90 days of system acceptance, these drawings shall be turned over to the Engineer. This shall apply particularly to underground and concealed work, and to other systems where the installation varies to a degree which would justify recording the change.

1.11 Operating and Maintenance Manuals

- A. Assemble two copies each of operating and maintenance manuals for the Electronic Safety and Security work.
- B. All "approved" shop drawings and installation, maintenance and operating instruction pamphlets or brochures, wiring diagrams, parts list, and other information, along with warranties, shall be obtained from each manufacturer of the principal items of equipment. In addition, prepare and include a chart listing all items of equipment which are furnished under this contract, indicating the nature of maintenance required, the recommended frequency of checking these points and the type of replacement material required. Name and address of a qualified service agency. A complete narrative of how each system is intended to operate.. Major items of equipment shall consist of not less than the following:

1. Access Control Systems.
 2. Intrusion Detection Systems.
 3. Video Surveillance Systems.
 4. Fire Detection and Alarm Systems.
 5. Detention Monitoring and Control Systems.
 6. UPS Systems.
- C. Standard NEMA publications on the operation and care of equipment may be furnished in lieu of manufacturer's data where the manufacturer's instructions are not available.
- D. Original purchase order number, date of purchase, name, address and phone number of the vendor, warranty information.
- E. Copy of required test reports.
- F. These shall be assembled into three-ring loose leaf binders or other appropriate binding. An index and tabbed sheets to separate the sections shall be included. These shall be submitted to the Engineer for review. Upon approval, manuals shall be turned over to the Owner.
- G. O & M manuals shall contain the following information at a minimum:
1. Copies of all approved shop drawings with the Engineer's stamp.
 2. Owner's manuals for every item of equipment when available from the manufacturer. These shall be the technical manuals provided by the manufacturer and shall not consist of generic sales brochures. Technical manuals shall provide complete specifications for the equipment as well as complete operating, maintenance, troubleshooting and product repair/replacement information. Where available only in electronic format, the contractor may provide a CD with electronic versions of Owner's manuals. CDs containing electronic versions of Owner's manuals must contain the proper software viewers for each document type.
 3. Electronic Safety and Security drawings updated with final as-built information. This shall be in the form of a complete set of Electronic Safety and Security drawings with as-built information indicated in colored pen based upon actual field conditions.
 4. System schematic and block diagrams for every system updated with final as-built information. These drawings shall define the exact arrangement of each system including wiring configuration, device locations and cable types.
 5. Rack elevations for all systems with rack mounted equipment.

1.12 Final Inspection and Punch List

- A. As the time of work completion approaches, survey and inspect Division 28 work and develop a punch list to confirm that it is complete and finished. Then notify the Engineer and request that a final inspection be made. It shall not be considered the Engineer's or Engineer's obligation to perform a final inspection until the Contractor has inspected the work and so states at the time of the request for the final inspection.
- B. Requests to the Engineer, Engineer for final inspection may be accompanied by a limited list of known deficiencies in completion, with appropriate explanation and schedule for completing these; this is in the interest of expediting acceptance for beneficial occupancy.
- C. The Engineer and/or Engineer will inspect the work and prepare a punch list of items requiring correction, completion or verification. Corrective action shall be taken by the Contractor to the satisfaction of Engineer and Engineer within 30 days of receipt of the Engineer/Engineer's punch list.

1.13 Warranty

- A. Warrant all workmanship, equipment and material entering into this contract for a period of one (1) year **or the period of time as per specific specification section** from date of final acceptance or date of beneficial use, as agreed to between Contractor and Engineer. Any materials or equipment proving to be defective during the warranty period shall be made good without expense to the Owner. Use of equipment for temporary electronic safety and security systems is not the start of the warranty period.
- B. This provision is intended specifically to cover deficiencies in contract completion or performance which are not immediately discovered after systems are placed in operation. These items include, but are not limited to replacement of malfunctioning equipment and adjusting special equipment and communication systems to obtain optimum performance.
- C. This provision shall not be construed to include maintenance items such as making normally anticipated adjustments or correcting adjustment errors on the part of the Owner's personnel.
- D. Provisions of this warranty shall be considered supplementary to warranty provisions under Division 01 - General Conditions.

PART 2 - PRODUCTS

2.1 Materials and Equipment

- A. Materials and equipment furnished shall be in strict accordance with the specifications and drawings and shall be new and of best grade and quality. When two or more articles of the same material or equipment are required, they shall be of the same manufacturer.
- B. All electrical equipment and wiring shall bear the Underwriters Laboratories, Inc. label where UL labeled items are available, and shall comply with NEC (NFPA-70) and NFPA requirements.

2.2 Reference Standards

- A. Where standards (NFPA, NEC, ASTM, UL, etc.) are referenced in the specifications or on the drawings, the latest edition is to be used except, however, where the authority having jurisdiction has not yet adopted the latest edition, the edition so recognized shall be used.

2.3 Equipment Selection

- A. The selection of materials and equipment to be furnished shall be governed by the following:
 - 1. Where trade names, brands, or manufacturers of equipment or materials are listed in the specification, the exact equipment listed shall be furnished. Where more than one name is used, the Contractor shall have the option of selecting between any one of the several specified. All products shall be first quality line of manufacturers listed.
 - 2. Where the words "or approved equal" appear after a manufacturer's name, specific approval must be obtained from the Engineer during the bidding period in sufficient time to be included in an addendum. The same shall apply for equipment and materials not named in the specifications, where approval is sought.
 - 3. Where the words "equal to" appear, followed by a manufacturer's name and sometimes a model or series designation, such designation is intended to establish quality level and standard features. Equal equipment by other manufacturers will be acceptable, subject to the Engineer's approval.
- B. Substitute equipment of equal quality and capacity will be considered when the listing of such is included as a separate item of the bid. State the deduction or addition in cost to that of the specified product.

- C. Before bidding equipment, and again in the preparation of shop drawings, verify that adequate space is available for entry and installation of the item of equipment, including associated accessories. Also verify that adequate space is available for servicing of the equipment and that required NEC clearances are met.
- D. If extensive changes in conduit, equipment layout or electrical wiring and equipment are brought about by the use of equipment which is not compatible with the layout shown on the drawings, necessary changes shall be deemed to be included in this contract.

2.4 Shop Drawings

- A. Electronic copies of shop drawings and descriptive information of equipment and materials shall be furnished. Submit to the Engineer and/or Engineer for review as stated in the General Conditions and Supplementary Conditions. These shall be submitted as soon as practicable and before equipment is installed and before special equipment is manufactured. Submittal information shall clearly identify the manufacturer, specific model number, approval labels, performance data, electrical characteristics, features, specified options and additional information sufficient to evidence compliance with the contract documents. Product catalogs, brochures, etc. submitted without project specific items marked as being submitted for review will be rejected and returned without review. Shop drawings for equipment, fixtures, devices and materials shall be labeled and identified same as on the Contract Documents. If compliance with the above criteria is not provided shop drawings will be subject to rejection and returned without review. Samples shall be submitted when requested or as specified here within.
- B. The review of shop drawings by the Engineer shall not relieve the Contractor from responsibility for errors in the shop drawings. Deviations from specifications and drawing requirements shall be called to the Engineer's attention in a separate clearly stated notification at the time of submittal for the Engineer's review.

PART 3 - EXECUTION

3.1 Testing

- A. As each wiring system is completed, it shall be tested for continuity and freedom from grounds.
- B. As each electrically operated system is energized, it shall be tested for function.
- C. The Contractor shall perform megger and resistance tests and special tests on any circuits or equipment when an authorized inspection agency suspects the system's integrity or when requested by the Engineer or Engineer.
- D. All signaling and communications systems shall be inspected and tested by a qualified representative of the manufacturer or equipment vendor. Refer to specific section for required tests of the various systems. Submit four (4) copies of reports indicating results.
- E. Tests shall be witnessed by field representatives of the Engineer or Engineer or shall be monitored by a recorder. Furnish a written record of each system test indicating date, system, test conditions, duration and results of tests. Copies of all test reports shall be included in the O&M manuals.
- F. Instruments required for tests shall be furnished by the Contractor.

3.2 Equipment Cleaning

- A. Before placing each system in operation, the equipment shall be thoroughly cleaned; cleaning shall be performed in accordance with equipment manufacturer's recommendations.

- B. Refer to appropriate Sections for cleaning of other equipment and systems for normal operation.

3.3 Operation and Adjustment of Equipment

- A. As each system is put into operation, all items of equipment included therein shall be adjusted to proper working order. This shall include balancing and adjusting voltages and currents; verifying phase rotation; setting breakers, ground fault and other relays, controllers, meters and timers; and adjusting all operating equipment.

3.4 Operating Demonstration and Instructions

- A. Set the various systems into operation and demonstrate to the Owner and Engineer that the systems function properly and that the requirements of the Contract are fulfilled.
- B. Provide the Owner's representatives with detailed explanations of operation and maintenance of equipment and systems. A thorough review of the operating and maintenance manuals shall be included in these instructional meetings.
- C. O & M Manuals shall be submitted, reviewed and approved prior to scheduling of demonstrations.
- D. A minimum of 24 hours shall be allowed for instructions to personnel selected by the Owner. Instructions shall include not less than the following:
 - 1. Show location of items of equipment and their purpose.
 - 2. Review binder containing instructions and equipment and systems data.
 - 3. Coordinate written and verbal instructions so that each is understood by personnel.
 - 4. Manufacturer's representatives for the various special and communication systems shall give separate instructions.
 - 5. All operating demonstrations and instructions for each system shall be audio/video digitally recorded and turned over to the Owner.
- E. A minimum of 48 hours continuous trouble-free operating time shall be acceptable to prove that the systems function properly.
- F. Note that additional time for training, operating time, etc. may be required per other specification sections and shall be included. This section only establishes minimum requirements.

END OF SECTION

PART 1 - GENERAL

1.1 Temporary Electronic Safety and Security Services

- A. The temporary Electronic Safety and Security for construction is provided by the Contractor. Refer to Division 01 – General Requirements.
- B. The use of the permanent Electronic Safety and Security system for temporary services during the latter stages of construction shall be allowed. Expedite completion of system as practicable to this end. Maintain the system during this period.
- C. Warranty periods on equipment, materials and systems shall commence upon Owner acceptance of the building or systems. Temporary use shall not jeopardize or alter warranty requirements.
- D. The complete temporary service shall comply with Owner Facility, OSHA and all Code requirements.

1.2 Continuity of Service

- A. Work shall be so planned and executed as to provide reasonable continuous service of existing systems throughout the construction period. Where necessary to disrupt services for short periods of time for connection, alteration or switch over, the Owner shall be notified in advance and outages scheduled at the Owner's reasonable convenience.
- B. Submit, on request, a written step-by-step sequence of operations proposed to accomplish the work. The outline must include tentative dates, times of day for disruption, downtime and restoration of services. Submit the outline sufficiently in advance of the proposed work to allow the Engineer to review the information with the Owner. Upon approval, final planning and the work shall be done in close coordination with the Owner.
- C. Shutdown of systems and work undertaken during shutdown shall be bid as being done outside of normal working hours.

PART 2 - PRODUCTS

2.1 Access Panels

- A. Ceiling and wall access panels shall be provided where indicated on the drawings, or where otherwise required to gain access to concealed junction boxes, pull boxes, devices and equipment requiring service or adjustment.
- B. Access panels (refer to paragraph C. below for more specialized drywall ceiling access panels) shall be steel construction (except where aluminum or stainless steel is specified) with concealed hinge and door with screwdriver lock. Panels shall be 18 inches x 18 inches size unless larger panels are shown or required. Mounting frames shall be compatible with the material in which they are installed. Access panels shall be:
 - 1. Standard flush type with overlapping flange for masonry and tile walls.
 - 2. Recessed type having the door recessed to accept a drywall panel insert, for drywall ceilings and walls, Milcor style "ATR" or equal.
 - 3. Standard flush type for drywall ceilings and walls, Milcor style "M" or equal.

- C. Access panels in drywall ceilings shall be glass reinforced gypsum drywall lay-in panels with flush mounting frames. Corners of panels shall be rounded. Panels shall be 18 inches x 18 inches unless larger panels are shown or required.
- D. Access panels in fire rated shaft walls and in fire rated ceilings shall be "B" label or greater to match the rating of the wall or ceiling.
- E. Materials used in plenums shall be rated for plenum use conforming to the ASTM E84 25/50 smoke development and flame spread restrictions.

PART 3 - EXECUTION

3.1 Workmanship

- A. Materials and equipment shall be installed and supported in a first-class and workmanlike manner by mechanics skilled in their particular trades. Workmanship shall be first-class in all respects, and the Engineer and Engineer shall have the right to stop the work if highest quality workmanship is not maintained.
- B. Electrical work shall be performed by a licensed Contractor in accordance with requirements of the jurisdiction.
- C. Electronic Safety and Security work shall be performed by certified Contractor in accordance with the respective specification and system requirements.

3.2 Protection

- A. The Contractor shall be entirely responsible for all material and equipment furnished in connection with his work. Special care shall be taken to properly protect all parts thereof from theft, damage or deterioration during the entire construction period in such a manner as may be necessary, or as directed by the Engineer.
- B. The Owner's property and the property of other contractors shall be scrupulously respected at all times. Provide drop cloths and visqueen or similar barriers where dust and debris is generated, to protect adjacent areas.

3.3 Cutting and Patching

Projects with Remodeling

- A. Refer to Division 01 - General Requirements for information regarding cutting and patching.
- B. Plan the work well ahead of the general construction. Where conduits, wireways, and cable trays are to pass thru new walls, partitions, floors, roof or ceilings, place sleeves in these elements or arrange with the General Contractor to provide openings where sleeves are not practical. Where sleeves or openings have not been installed, cut holes and patch as required for the installation of this work, or pay other trades for doing this work when so directed by the Engineer. Any damage caused to the building shall be repaired or rectified.
- C. Where conduits, wireways and cable trays are to pass thru, above or behind existing walls, partitions, floors, roof or ceiling, cutting, patching, refinishing and painting of same shall be included in this contract. Core drilling and saw cutting shall be utilized where practical. Contractor to examine where floors and walls, etc. are to be cut for presence of existing utilities.
- D. When cutting or core-drilling floor verify location of existing electrical, plumbing or steel reinforcement. Use X-ray method to verify existence of obstructions. Either re-route existing system brace floor or alter location of new work to maintain existing system.

- E. All sleeves and openings not used or partially used shall be closed to prevent passage of fire or smoke.
- F. All materials, methods and procedures used in patching and refinishing shall be in accordance with applicable provisions of specifications governing the various trades, and shall be completed by skilled workmen normally engaged in these trades. The final appearance and integrity of the patched and refinished areas must meet the approval of the Engineer. Wall, floor and ceiling refinishing must extend to logical termination lines (entire ceiling of the room repainted, for instance), if an acceptable appearance cannot be attained by finishing a partial area.
- G. Provide steel angle or channel lintels to span openings which are cut in existing jointed masonry walls where the opening span exceeds 16 inches. Provide framing around roof openings for required support of the roof deck.
- H. Engage a Roofing Contractor on a subcontract basis for roofing and roof insulation work necessitated by the Electronic Safety and Security work. The Roofing Sub-Contractor shall be certified for installation and repair of the roofing system so as to maintain the existing roofing warranty.

3.4 Removals, Alterations and Reuse

- A. Refer to the drawings for the scope of remodeling in the existing building.
- B. Cooperate regarding all removal and remodeling work. The Contractor shall remove existing work which is associated with his trade, and which will be superfluous when the new system is installed and made operational. Void unused conduit behind walls or below floors as necessary or as directed. No wire or conduit shall be removed which will impair the functioning of the remaining work unless first replaced with a rerouted section of wire or conduit to ensure continuity. Remove inactive wiring back to the last active junction box, panelboard or piece of equipment.
- C. Upon completion, no unused conduit or stub shall extend thru floors, walls or ceilings in finished areas. Abandoned conduit where remaining in place shall have any unused wiring removed. If the abandoned conduit is adequately supported it may remain at the discretion of the Miami University Project Manager and is to be marked on the as built record drawings in BRIGHT PINK. All accessible unused conduit shall be removed.
- D. When it is necessary to reroute a section of an active circuit, the rerouted section shall be installed before removing the existing in order to minimize system down time. Rerouted sections shall be installed as required for new work.
- E. Materials and equipment which are removed shall not be reused within the scope of this project unless specifically noted to be relocated or reused. Turn over to the Owner and place where directed on the premises all removed material and equipment so designated by the Owner. All material and equipment not claimed by the Owner shall become the property of the Contractor responsible for removal and shall be removed from the premises.
- F. Remove, store and reinstall lay-in ceiling tile and grid as needed to perform work in areas where such removal and re-installation is not to be done by the General Contractor. Damaged tile and/or grid shall be replaced with new matching tile and/or grid.
- G. In areas of minor work where the space is not completely vacated, temporarily move portable equipment and furnishings within the space as required to complete the work. Coordinate this activity with the Owner. Protect the Owner's property by providing dust covers and temporary plastic film barriers to contain dust. Remove barriers and return equipment and furniture upon completion of the work.

- H. Refinish any surface disturbed under this work to match existing, except where refinishing of that surface is included under another Contract.

3.5 Painting

- A. In addition to any painting specified for various individual items of equipment, the following painting shall be included in Division 28:
 - 1. Ferrous metal which is not factory or shop painted or galvanized and which remains exposed to view in the building including finished areas, mechanical rooms, storage rooms, and other unfinished areas shall be given a prime coat of paint and two finish coats of paint.
 - 2. Ferrous metal installed outside the building which is not factory or shop painted or galvanized shall be given a prime coat of paint and two finish coats of paint.
 - 3. Equipment and materials which have been factory or shop coated (prime or finished painted or galvanized), on which the finish has been damaged or has deteriorated, shall be cleaned and refinished equal to its original condition. The entire surface shall be repainted if a uniform appearance cannot be accomplished by touch up.
 - 4. Apply Z.R.C. Galvilite / 221 cold galvanizing compound, or approved equal, for touch-up and repair of previously galvanized surfaces.
 - 5. Each backboard shall be painted with a minimum of two coats of flame retardant paint, all sides; gray enamel primer with gray matte enamel finish.
- B. Paint, surface preparation and application shall conform to applicable portions of the Painting section of Division 01 of the Specifications. All rust must be removed before application of paint.
- C. Finish painting is included in the Contract except where otherwise required under remodeling work. Refer to the Cutting and Patching paragraph in this Section for finishing requirements.

3.6 Access Panels

- A. Access panels shall be turned over to the General Contractor for installation.
- B. Access locations thru HVAC ductwork must be coordinated with the ductwork installer. Location of the hinged access door with latch must be coordinated in advance with the HVAC Contractor.
- C. Location of access panels shall be planned to clear ceiling lights, ceiling support grids and other obstructions so as to allow, wherever possible, full shoulder clearance beside the device to be inspected, adjusted or repaired.
- D. Panels with recessed doors are to be fitted with insert panels of drywall. Caution the Installing Contractor to provide appropriate framing with drywall beading to ensure a finished appearance. Shim strips may be required to bring the insert panel flush with the plane of the door and wall / ceiling.

3.7 Backboards

- A. Where shown on the drawings, backboards shall be provided for wall mounting of disconnect switches, devices and Electronic Safety and Security equipment. The Contractor may opt to mount additional groups of disconnect switches on backboards.
- B. General
 - 1. Backboard shall be 0.75 inches thick waterproof flame retardant plywood secured to structure.

2. Each board shall be painted.
3. Electronic Safety and Security backboards shall be normally 4 ft. x 8 ft. mounted 6 inches above floor where located on drawings. Where other sizes are required, they will be noted on the drawings.

END OF SECTION

PART 1 - GENERAL

- 1.1 Firestopping assemblies shall be provided at penetrations of conduits, cables, cable trays and other electrical items thru fire rated floors, fire rated floor-ceiling and roof ceiling assemblies, fire rated walls and partitions and fire rated shaft walls and partitions. In addition, firestopping assemblies shall be provided at penetrations thru 0-hour rated floors. Refer to the drawings for fire rated building elements.
- 1.2 Firestopping assemblies shall be tested and rated in accordance with ASTM E814, E119 and listed in accordance with UL 1479, as published in the UL Fire Resistance Directory. Firestopping shall provide a fire rating equal to that of the construction being penetrated.
- 1.3 Firestopping materials, assemblies and installation shall conform to requirements of the OBC / Chapter 1, Section 106 and Chapter 7, Section 712 and the Authority Having Jurisdiction.
- 1.4 For those firestopping applications that exist for which no UL tested system is available through any manufacturer, a manufacturer's engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by the International Firestop Council.
- 1.5 Shop drawings shall be prepared and submitted for review and approval. Submittals shall include manufacturer's specifications and technical data of each material, documentation of U.L. firestopping assemblies and installation instructions. Submittals shall include all information required in OBC Chapter 1, Section 106 and Chapter 7, Section 712.

PART 2 - PRODUCTS

- 2.1 Firestopping materials shall be manufactured and/or supplied by Hilti, 3M, Rectorseal-Metacaulk, Tremco, Nelson, Specified Technologies or other approved manufacturer.
- 2.2 Materials shall be in the form of caulk, putty, sealant, intumescent material, wrap strip, fire blocking, ceramic wool and other materials required for the UL listed assemblies. These shall be installed in conjunction with sleeves and materials for fill and damming.
- 2.1 Combination pre-set floor sleeve and firestopping assemblies shall be equal to Hilti CP 680.

PART 3 - EXECUTION

- 3.1 Installation of all materials and assemblies shall be in accordance with UL assembly drawings and the manufacturer's instructions.
- 3.2 Installation shall be done by an experienced installer who is certified, licensed or otherwise qualified by the firestopping manufacturer as having the necessary training and experience.
- 3.3 Refer to 28 05 33 Raceway and Boxes for Electronic Safety and Security Systems for sleeve requirements and treatment of penetrations not requiring firestopping.
- 3.4 Work to be performed by a Licensed Electrician.

END OF SECTION

PART 1 - GENERAL

- 1.1 Work includes grounding and bonding of system neutral, equipment and conduit systems to conform to requirements of NEC and as detailed on the plans and in the specifications.
- 1.2 Technology Grounding Description
- A. Provide bonding to all conduit sleeves. Provide bonding to all technology equipment racks and cabinets within each wiring closet.
 - B. This contract shall be responsible for providing all equipment, cable tray, ladder rack, conduit and sleeve grounding in each TC to the grounding system installed under Division 26.
 - C. All work shall be in compliance with NEC, Article 250 and EIA/TIE J-STD-607.
- 1.3 Relevant Standards
- A. The Telecommunications Grounding Installation shall comply with the following at a minimum:
 - 1. All local, state and national codes
 - 2. The National Electric Code (NEC)
 - 3. The National Electrical Safety Code (NESC)
 - 4. Electronic Industries Alliance (EIA) / Telecommunications Industry Association (TIA) 606, J-STD-607 and all applicable and current Technical Service Bulletins (TSB).

PART 2 - PRODUCTS

- 2.1 Clamps and continuity devices shall be non-ferrous material, UL approved. Connections to ground rods and all underground connections shall be "Thermoweld" or "Cadweld".
- 2.2 Ground conductors shall be insulated, identified by green insulation or by painting or taping green at all accessible locations and shall be connected with approved connectors and terminators to boxes, devices, equipment, etc. and to ground bars in panels.
- 2.3 Bonding Conductors
- A. Conductor shall be minimum #6AWG and may be either stranded or solid, insulated or bare.
 - B. Cable as manufactured by Superior/Essex, Rome, AIWC.
 - C. All connections shall be made with double-bolted, compression style grounding lugs.

PART 3 - EXECUTION

- 3.1 Work to be performed by a licensed Electrician
- 3.2 Wiring devices shall be connected with grounding jumper from ground pole on device to grounding screw in the outlet box.
- 3.3 The complete metal conduit system shall be used for the equipment grounding system. Conduit systems and associated fittings and terminations shall be made mechanically tight to provide a continuous electrical path to ground and shall be safely grounded at all equipment by bonding all

metallic conduit to the equipment enclosures with locknuts cutting thru paint or enclosures. Bond all conduits entering primary switchgear, pad-mount transformers, unit substations, emergency generator control panel and main breaker panel, and secondary service entrance switchboard with a ground wire connecting the grounding type bushings to the equipment ground bar. Conductors shall be sized per NEC Tables 250 66 and 250 122. Bond all communications conduit systems to ground.

- 3.4 In addition to using the conduit system for grounding, a complete auxiliary green wire equipment grounding system shall be installed, continuous from main ground, thru distribution and branch circuit panelboards and paralleling all feeders and branch circuit wiring. Grounding conductor sizes shall comply with NEC Table 250 122, minimum size shall be #12 copper except #14 on control circuits. This shall apply to all circuits rated 100 volts or more above ground potential.
 - A. Connect ground terminal on wiring devices to auxiliary green wire equipment grounding system.
- 3.5 Ground neutral of all transformers for separately derived systems. Grounding electrode conductor shall be to the street side of the main water service. A bond ground ran to nearest water piping and structural steel in area or to other NEC approved electrodes. A common grounding electrode size #3/0 may be used for multiple separately derived systems.
- 3.6 Cord connected appliance frames shall be grounded to the equipment grounding system thru a green wire in the cord.
- 3.7 A green grounding conductor shall be installed in each non-metallic conduit and all flexible conduits, including exterior underground conduits.
- 3.8 System neutral connections shall be insulated from metal enclosures except at the neutral of the service entrance equipment and on the neutral of a separately derived system. Connections to the main switchgear enclosure shall be by means of bonding jumpers.
- 3.9 The building neutral shall be identified throughout with white conductors. Where there are neutral conductors from a separately derived system (such as 120/208 volt, 3 phase, 4 wire where the main building service is 277/480 volt, 3 phase, 4 wire) the neutrals of the two systems shall be separately identifiable per NEC Article 200.
- 3.10 Grounding/Bonding Connections
 - A. Ground all backbone cable sheaths, shield drain wires from all voice/data horizontal cable, equipment racks and equipment to the local TGB / MTGB.
 - B. All grounding and bonding shall be in conformance with the National Electric Code, article 250 and as recommended by EIA/TIA-607.
 - C. All connection to ground bars (TGB, TMGB) shall be made using listed lugs appropriate for mounting provisions in the supplied ground bar.
- 3.11 Labeling
 - A. The Contractor shall be responsible for labeling all telecommunications grounding equipment, cable, etc. in accordance with the guidelines as described herein.
 - B. Each telecommunications ground bar shall be provided with a warning label to read:
 1. "WARNING: Building telecommunications grounding system. Do not remove or disconnect without prior approval from building Telecommunications Department."

- C. Each Telecommunications Bonding Conductor (TBC, TBB, GE, etc.) to be provided with a label indicating source and destination ground bars.

END OF SECTION

**28 05 28 ELECTRONIC SAFETY AND SECURITY SYSTEMS
PATHWAYS AND SUPPORT EQUIPMENT**

PART 1 - GENERAL

1.1 Scope of Work

- A. Work consists of pathways to carry Electronic Safety and Security wiring of all descriptions, including empty conduits, conduit sleeves, cable management systems, etc.
- B. Work includes support equipment for Electronic Safety and Security cabling including backboards, rough-in boxes and cabinets.

1.2 Quality Assurance

- A. Electronic Safety and Security pathways and support equipment shall be closely coordinated with other trades to provide adequate access, appropriate clearances and required separation between systems.

1.3 Shop Drawings – Submit shop drawings including product data sheets and diagrams per requirements including the following:

- A. A complete list of materials with model and part numbers and reference to the specification paragraph number.

1.4 Drawings

- A. The drawings, which constitute a part of these bid documents, indicate the general route of the pathways to carry communication wiring systems. Data presented on these drawings are as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification, of all dimensions, routing, etc., is directed.
- B. Specifications and drawings are for assistance and guidance, but exact routing, locations, distances and levels will be governed by actual field conditions. Contractor is directed to make field surveys as part of his work prior to submitting system layout drawings.

1.5 Related Work by Others

- A. Electronic Safety and Security cabling shall be the included as stated in the specification section for each individual system.

PART 2 - PRODUCTS

2.1 Conduit Systems

- A. Refer to Specification Section 28 05 33 - Raceway and Boxes for Electronic Safety and Security Systems.

2.2 Cable Management System

- A. Provide pre-manufactured cable supports as manufactured by Panduit, Caddy, Mineralac or Rayco. Cable supports shall be secured to building structure through threaded rod, beam clamps or other UL approved supports as required by site conditions. Components shall provide a minimum cable support point spacing of 48 inches.

- B. Cable management devices must be sized to accommodate 100 percent spare capacity of the final installed cable base.
- C. Cable management system support components shall be designed with wide support surfaces that do not cause cables to be bend, crushed or otherwise deformed when installed within component loading parameters. Cable management system shall meet UL standards and be UL labeled. Utilizing elements of the building's structure such as beams, joists, etc. to hang cable from will not be acceptable.
- D. Bridle rings shall not be acceptable.

2.3 Backboards

- A. Refer to Section 28 05 04 – Basic Electronic Safety and Security Materials and Methods.

2.4 Rough-In Boxes

- A. Refer to Section 28 05 33 – Raceway and Boxes for Electronic Safety and Security Systems.
- B. Refer to drawings for types, quantities and configurations of outlet boxes used to serve Electronic Safety and Security Cabling.

PART 3 - EXECUTION

3.1 General Installation

- A. Work to be performed by a licensed Electrician.
- B. Refer to drawings for pathway types, locations and routing.
- C. Cable pathways shall provide the following minimum clearances:
 - 1. Motors and transformers – 4 ft.
 - 2. Conduit and cable used for electrical power distribution – 1 ft.
 - 3. Fluorescent lighting – 5 inches.
 - 4. Power lines up to 5 kV – 5 inches.
 - 5. Power lines over 5 kV. – 24 inches.
- D. Backboards and cabinets shall be installed in Electronic Safety and Security rooms/spaces to support Electronic Safety and Security equipment and wiring. Coordinate locations of backboards and cabinets with the Owner prior to installation.
- E. Restore fire rating and smoke stoppage integrity where all wireways, raceways and cable trays pierce walls, floors and ceilings by sealing with approved means; refer to Raceway and Boxes for Electronic Safety and Security Systems paragraph 28 05 33 and Firestopping paragraph 28 05 05.
- F. Provide necessary pathways in areas that have exposed structure or plastered ceilings to provide a wiring path for cables from area above suspended ceilings to respective backboards.
- G. No non-metallic or combustible materials shall be installed in ceiling or other plenums used for circulating room air used for heating, ventilation or cooling.

3.2 Conduit Systems

- A. No section of conduit shall be longer than 100 feet between pulling points.
- B. No more than two 90 deg. bends in a section of conduit between pulling points.
- C. Each section of conduit shall be labeled for length, destination closet and origination closet.
- D. Refer to EIA/TIA 569-A for specific conduit and pull box requirements.
- E. Conduit and wiring above accessible ceilings shall be run as high as possible, above piping and ductwork, so as to not interfere with mechanical trades, access to mechanical and electrical devices and to allow freedom to remove ceiling panels.
- F. Provide a No. 12 gauge pull wire or nylon pull cord in each empty conduit run.

3.3 Cable Management System

- A. The drawings do not indicate specific routes for cables. The Division 28 Contractor is responsible for developing all cabling routes utilizing existing cable management pathways and systems or providing supplemental management pathways and systems so that all structured cabling adhere to specific codes and standards specifically developed for the installation of such cables. Where the use of existing cable management systems and pathways would cause the structured cable system to violate specific codes and standards regarding cable lengths, environments, proximity to EMI and RF noise sources, etc., the Division 28 Contractor shall be responsible for developing alternative pathways and shall include all labor and material for doing so within the scope of this work.
- B. In areas where there is not an installed raceway system (conduits or cable tray) and a cable support system is required, this contract shall be responsible for providing a cable management system. Where cables are installed open wired through the use of cable management systems, they shall be installed such that there is a minimum sag of 4 inches for every 4 foot of horizontal run. Cable pathways shall provide the following minimum clearances:
 - 1. Motors and transformers – 4 feet.
 - 2. Conduit and cable use for electrical power distribution – 1 feet.
 - 3. Fluorescent lighting – 5 inches.
 - 4. Power lines up to 2kVA – 5 inches.
 - 5. Power lines over 5kVA – 24 inches cable management system shall be secured to building structure utilizing manufactured approved methods and hardware.
- C. Cable management system support components shall be designed with wide support surfaces that do not cause cables to be bent, crushed or otherwise deformed when installed within component loading parameters. Cable management system shall meet UL standards and be UL labeled. Utilizing elements of the building's structure such as beams, joists, etc. to hang cable from will not be acceptable.

3.4 As-Built Documentation

- A. Provide a complete set of architectural floor plan drawings indicating final communications pathway systems with accurate "as-built" locations to show the actual route for the communications systems pathways.
- B. Drawings shall indicate each pathway type and provide sizing information such as conduit/innerduct diameter, cable tray width, cable management ring size, etc.

- C. Component Service Manuals: Include information for testing, repair, troubleshooting, assembly, disassembly, and required / recommended maintenance intervals for all types of pathways.
- 3.5 Restore fire rating and smoke stoppage integrity where all wireways, raceways and cable trays pierce walls, floors and ceilings by sealing with approved means; refer to Raceway and Boxes for Electronic Safety and Security Systems Section 28 05 33.

END OF SECTION

**28 05 33 RACEWAY AND BOXES
FOR ELECTRONIC SAFETY AND SECURITY SYSTEMS**

PART 1 - GENERAL

- 1.1 This specification section covers common conduit systems, boxes, sleeves and firestopping. Where other methods are specified under separate sections for specific applications, the specific application requirements shall govern.
- 1.2 Refer to Section 28 05 05 Firestopping and Division 07 for firestopping requirements.
- 1.3 Refer to Section 28 05 28 "Electronic Safety and Security Systems Pathways and Support Equipment".

PART 2 - PRODUCTS

- 2.1 Conduit Type Application (Use only conduit types listed)
- A. Conduit Rigid or Intermediate Grade Galvanized Threaded.
Application restrictions (Not to be used in):
1. Direct buried in corrosive soils.
 2. Corrosive atmospheres.
- B. Conduit - Thinwall EMT.
Application - restrictions - (Not to be used in):
1. Poured concrete.
 2. Exposed to weather.
 3. Underground.
 4. Exposed in mechanical equipment or other equipment/process rooms below 48 inches.
 5. Hazardous or corrosive atmospheres.
 6. Not to be used for medium voltage (2001 volts or higher) cable.
 7. Not to be used in utility tunnels.
- 2.2 Conduit sizes
- A. Conduits shall be 0.75 inches minimum size.
- 2.3 Conduit Fittings
- A. Fittings and workmanship shall ensure electrical continuity. All conduit systems in poured concrete shall be concrete tight.
- B. Application of bushings, locknuts and insulated fittings shall comply with NEC requirements.
- C. Use conduit fittings as manufactured by Efcor, Steel City, Raco, Midwest, Appleton, ETP / O-Z / Gedney or T&B, equal to the following catalog numbers:
1. Rigid conduit
 - all fittings, couplings and connectors shall be threaded type.
 - grounding bushings, malleable iron; insulated; Steel City BG-801; Midwest Series GLL.
 2. EMT
 - fittings shall be all steel, set screw, concrete tight.
 - set-screw type couplings; Midwest Series 460; Steel City TK 121; Appleton TW 50S.

- set-screw type connectors with insulated throats; Midwest Series 450; Steel City TC 121; Appleton TWC 50S..

2.4 Boxes

- A. Junction boxes and pull boxes shall be code gauge galvanized steel with multiple screw fasteners and covers.
- B. Outlet boxes all steel construction with galvanized or plated finish or otherwise all metal, by Steel City, Appleton, Crouse Hinds, R&S or Raco.
 1. Lighting fixture outlet boxes 4 inches square or octagonal, 2.125 inches deep, with 0.375 inches fixture studs. Equal to Steel City Series 54171; Series 52171 with FE 421 stud. Fixtures weighing more than 50 lbs. shall be supported independently of the outlet box.
 2. Flush mounted device outlet boxes shall be minimum 4 inches square. Provide extension rings as required. Use Caddy No. H2-3 mounting support plate where metal studs are used.
 3. Device rings in finished masonry or tile walls shall be square corner masonry type with no extended ears, to allow flush mounting of plates.
 4. Floor boxes shall be UL listed for its application as manufactured by Hubbell, Steel City, Walker or Raco.
 5. Surface mounted device boxes shall be cast "FS" type or special surface mounted boxes for use with surface raceway systems.
- C. Provide water tight boxes, slip expansions and bonding jumpers where dictated by construction conditions.
- D. Terminations at boxes shall be secured by locknuts or approved bushings.

2.5 Sleeves and Openings

- A. Sleeves and formed openings shall be placed in walls, partitions, floor slabs and poured concrete roof decks for the passage of conduit, cable, wireway and cable tray. Sleeves and formed openings are not required:
 1. In floor slabs on grade.
 2. Where conduit is installed before the wall, partition or slab is constructed.
 3. Openings are cut for conduit passage and patched with equal or comparable material to close the space around the conduit.
 4. In stud and gypsum board or plaster walls and partitions which are not fire rated.
 5. For conduit passing thru masonry walls and partitions and stud and gypsum board or plaster walls and partitions. Sleeves are required however, for which expansion, contraction and other movement can be expected.
 6. In core drilled openings in solid concrete not requiring water protection. Sleeves are required, however, at core drilling thru hollow pre-cast slabs and concrete block walls, to facilitate containment of required firestopping material.
 7. In large floor openings for multiple pipe and duct risers which are within a fire rated shaft, unless the opening is to be closed off with concrete or other material after conduits are set.
- B. Sleeves for passage of conduit and cables shall be schedule 40 black steel pipe or galvanized rigid conduit. Rectangular sleeves for cables, wireway, cable tray and bus duct shall be 18 gauge galvanized steel in poured concrete floors, walls and roof decks; 26 gauge galvanized sheet steel in other than poured concrete.
- C. Sleeves shall be sized to afford 0.25 inches to 0.75 inches clearance space.

- 2.6 In areas having special membrane waterproofing in or on the floor slab, a Josam 26420, or equal approved by the Architect, riser sleeve with clamping ring and auxiliary conduit sleeve extending 4 inches above finished floor or 8 inches above finished roof shall be used. Waterproofing membrane for roof floor construction shall be secured by the clamping ring. These are to be used in areas having special membrane water-proofing in or on the floor slab and at roof decks.
- 2.7 Multiple conduits extending through the roof may be fitted with a manufactured pipe curb weatherproofing assembly equal to Pate pca, lpca and mpca as an alternative to that specified in paragraph 2.7 above.
- 2.8 Escutcheon plates shall be split-ring chromium plated pressed steel. Plates shall be sized to cover the surface penetration and sleeve. Plates shall be installed on exposed piping in finished rooms and areas where conduits penetrate walls, floors, ceilings or overhead structure.
- 2.9 Anchors and Fasteners
 - D. Anchors and fasteners shall be of a type designed and intended for use in the base material to which the material support is to be attached and shall be capable of supporting the intended load and withstanding any associated stresses and vibrations.
 - E. In general, screws shall be used in wood, masonry anchors on concrete or brick, toggle bolts in hollow walls, and machine screws, bolts or welded studs on steel.
 - F. Nails shall not be used except for temporary support or for light loads in wood frame construction.
 - G. In outdoor locations or other corrosive atmospheres, the anchors and fasteners shall be non-corrosive or have suitable corrosion resisting coatings.

PART 3 - EXECUTION

- 3.1 Work to be performed by a licensed Electrician.
- 3.2 Conduit shall be run concealed in all finished areas of new construction and elsewhere unless specifically indicated or upon specific permission by the Architect. All conduit shall parallel building lines.
- 3.3 Conduit shall be run overhead and shall not be run in or below concrete slabs unless specifically indicated on the drawings.
- 3.4 All conduits installed below concrete slab on grade shall have a minimum of 6-inches fill over the conduits in order to prevent accidental damage to conduits should the floor be saw-cut in the future.
- 3.5 Conduits shall not be installed above the vapor barrier in concrete floors poured on grade.
- 3.6 Conduit crossing building expansion joints shall have expansion provisions with grounding continuity; use special expansion fittings or other NEC approved method. Refer to the architectural and structural floor plans and details for locations of expansion joints.
- 3.7 Do not install wall-mounted boxes back-to-back in opposite sides of wall; in stud walls, boxes shall be on opposite side of studs. In acoustic rated walls, boxes shall be separated a minimum of 24 inches.

- 3.8 Boxes not otherwise accessible in ceilings and walls shall be made accessible by installation of hinged door access panels. Refer to Section 28 05 04 - Basic Electronic Safety and Security Materials and Methods.
- 3.9 Use cast floor boxes for installation in slab on grade: Formed steel boxes are acceptable for other installation.
- 3.10 Work shall be so planned as to:
- A. Minimize the number of offsets and junction boxes. For feeder conduits, use all long radius conduit bends or accessibly located large junction boxes with screw covers.
 - B. Generally run conduit and conductors as high as practicable against underside of floor slab in concrete construction or immediately below the top chord of bar joist construction unless otherwise shown. This high level zone shall be used for running electrical raceways. Running conduits promiscuously at various levels and directions will not be acceptable. Runs at bottom chord level or ceiling grid level will not be acceptable.
 - C. Where spray on fireproofing is used, coordinate with the General Contractor about installing supports, panel feeders and larger conduits before fireproofing is applied. Branch circuit conduits and smaller size conduits may be run as high as possible on stud walls that go all the way up to the structure; this will minimize damage to spray on fireproofing. Patch and repair damaged spray on fireproofing caused by electrical installation; conduits shall not be fully covered with fireproofing.
 - D. Coordinate activity in advance to avoid interference with other trades.
 - E. Provide access to all junction and pull boxes.
 - F. Maintain 6 inches from conduit to paralleled hot water piping and 4 inches from cross piping and 12 inches from generator exhaust piping.
- 3.11 Secure feeder conduit to basic structural elements with galvanized strap hangers and clamps; use of trapeze type hangers is encouraged for multiple conduits where space will permit. Galvanized metal clamps and screws may be used for attaching and supporting branch circuit conduit. Non-metallic fasteners shall not be used except plastic inserts may be used in concrete for small conduits. Vertical conduits shall be supported at each floor by clamps.
- 3.12 Surface mounted horizontal and vertical conduit supports on walls up to a height of 7 feet-0 inches above the floor shall be one or two hole sheet metal pipe straps. Pinch type hangers similar to Minerallac type may only be used at heights greater than 8 feet-0 inches. The use of pinch type hangers similar to Minerallac type are expressly prohibited on ductwork, air handling units and other mechanical equipment below 8 feet-0 inches.
- 3.13 During construction temporarily cap open ends of conduit. Caution trades to take special care of runs in concrete slabs during pouring.
- 3.14 Empty conduit installed for communications use or for future systems shall have an insulated pull wire or heavy nylon cord inserted for use in pulling wires.
- 3.15 Pull mandrel or large swab thru conduit to ensure freedom from debris before pulling wires. Use pulling lubricants sparingly.
- 3.16 Sleeves for passage of conduit, cables, wireway, cable tray and bus duct shall be placed in the initial stages of construction before concrete, masonry and other general construction activity. Means shall be taken to ensure that the sleeve will not move during or after construction. Beams, columns and other structural members shall not be sleeved except upon approval of the Architect.

- 3.17 Length of wall sleeves shall be such that the sleeve ends are substantially flush with both sides of the wall or partition. Floor sleeves shall be flush with the bottom and top of the floor slab except, in mechanical rooms and other areas which might have water on the floor, sleeves shall project a minimum of 1 inch above finished floor. Refer to the following paragraph for qualifications and exceptions relating to firestopping.
- 3.18 Refer to 28 05 05 Firestopping. Sleeves which are a part of firestopping assemblies shall conform to the requirements of the assembly with particular emphasis regarding size, annular space, length, passage or non-passage of insulation and the installation of the sleeves.
- 3.19 Where firestopping is not required, the annular space between the sleeve, core drilling or opening and the conduit, cable, cable tray, bus duct and raceway shall be closed with caulking to retard the passage of smoke.
- 3.20 Where permitted by OBC Section 712 Penetrations, metallic conduits requiring no pipe sleeves in passing thru concrete floors or concrete or masonry walls and partitions, the annular space shall be closed full depth of the penetration with materials and methods compatible with the floor, wall or partition material (concrete, grout or mortar).
- 3.21 Openings for multiple conduits extending through floors where water protection is required (mechanical rooms, kitchens, other potentially wet areas) may be protected with a 4 inch high by 4 inch wide concrete curb with chamfered corners in lieu of individual sleeves. These concrete curbs may be used in lieu of the Josam 26420 riser sleeve and clamping ring provided the floor membrane and curbing are arranged to maintain the integrity of the membrane.
- 3.22 Conduits, wire and cables entering from outside the building shall be sealed water and moisture tight. Seal between conduit and sleeves, conduits and core drilled holes and around conductors inside conduits.
- 3.23 Conduits extending through the roof shall be made watertight by means compatible with the roofing system and as directed by the Roofing Contractor (the company who presently holds the warranty on the roof) and approved by the Engineer.
- 3.24 Powder actuated fasteners of any type are prohibited in occupied buildings. This includes anchors which are driven into place by any device which produces an impact force by use of a powder charge, compressed air, gas or any other propellant.
- 3.25 All conduit terminations to be equipped with locknuts and bushings. Conduits 1-1/2 inches and larger shall have insulating bushings, grounding lug and shall have locknuts inside and outside the enclosure.
- 3.26 Outlet Box Installation
 - A. Set box square and true with finished building surfaces and trim.
 - B. Secure boxes firmly to building structure.
 - C. Verify location of outlets and switches in finished rooms with Architectural Drawings of interior details and finish. In centering outlets and locating boxes, allow for overhead pipes, ducts and mechanical equipment, variations in fireproofing and plastering, window and like, and correct any inaccuracy from failure to do so without expense to the Owner.
 - D. Maintain symmetry of all outlets as closely as possible within Architectural Elevation contained. For example, the Contractor shall center light fixture over doorway or receptacle in section of masonry wall, if shown in that approximate position. If receptacle is shown in same location as counter or bench, determine countertop height and set receptacle to clear top and trim of counter and render outlet easily accessible.

- E. In the event of conflict between locations of electrical outlets as shown on the Electrical Drawings and on the Architectural Drawings, outlets shall be installed in accordance with the latter.
 - F. Locate light switches on latch side of door and verify door hinge location in field prior to switch outlet installation.
 - G. The Owner reserves the right to relocate any device as much as 10 feet-0 inches (measured horizontally) from its indicated location at no additional cost, provided the contractor is notified prior to roughing that device in.
- 3.27 Contractor shall record carefully on a set of "as built" prints the exact location of all feeder conduits.

END OF SECTION

28 11 00 COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 Scope of Work

- A. The intent of this specification section is to cover the materials and installation of a communications equipment room fitting system as outlined herein and as detailed on the drawings. Work shall consist of:
 - 1. Telecommunications Room termination and cable management including cabinets, backboards, backboard mounted wire management, etc.
 - 2. Cable management system within racks and cabinets.

1.2 System Description

- A. Termination Equipment – Racks and Cabinets
- B. Cable Management – Rack mounted horizontal and vertical cable management, backboards, backboard mounted cable management.

1.3 Quality Assurance

- A. All work shall be installed in compliance with the latest edition of the Commercial Building Telecommunications Wiring Standard EIA/TIA. BICSI Standards, applicable National Electric Code Sections, Ohio Building Codes.

1.4 Shop Drawings

- A. A complete list of materials with model and part numbers and references to the Part 2 specification paragraph numbers.

1.5 Relevant Standards

- A. The structured cabling installation shall comply with the following at a minimum:
 - 1. All local, state and national codes.
 - 2. The National Electric Code (NEC)
 - 3. The National Electrical Safety Code (NESC)
 - 4. Electronic Industries Alliance (EIA) / Telecommunications Industry Association (TIA) 526, 568, 569, 598, 606, J-STD-607, 758 and all applicable and current Technical Service Bulletins (TSB).

PART 2 - PRODUCTS

2.1 Product Equivalency

- A. Where products are listed with multiple manufacturers, these manufacturers will be approved as equals **if all specified features are provided**. Any equipment not specifically approved in writing prior to the bid date will not be considered regardless of qualifications. Failure to provide the "precise functional equivalent" shall result in the removal of the alternate equipment at the Contractor's expense.
- B. Different manufacturers may require various options, accessories, converters, patch cables, etc. to perform the specified features and functions. Therefore, all material and/or equipment necessary for proper operation of the system shall be deemed part of these specifications.

2.2 Floor Standing, Enclosed, deep

- A. Provide full height, enclosed, 30" usable depth, equipment cabinet with steel frame, adjustable side rails and back, solid side panels, locking solid rear door, locking front plexiglass door, levelers and top mounted thermostatically controlled "quiet" fan. Rails to be 10-32 thread fully tapped. Final rack configuration including rail width, useable depth, etc. to be carefully coordinated with installed equipment prior to ordering.
- B. Provide all required 120V power distributed through rack as required by installed equipment from local UPS unit and to dedicated receptacle in room.
- C. Refer to drawings for cabinets quantities and locations.
- D. Racks as manufactured by Rittal, Hubbell, APW, Chastworth, X-Mark, B Line.

2.3 Backboards

- A. Where shown on the drawings, backboards shall be provided for wall mounting of devices and technology equipment.
- B. General
 - 1. Backboard shall be 0.75 inch thick waterproof flame retardant plywood secured to structure.
 - 2. Each board shall be painted with fire retardant paint.
 - 3. Backboards shall be normally 4 ft. x 8 ft. mounted 6 inch above floor. Where other sizes are required, they will be noted on the drawings.
- C. Refer to drawings for quantities and arrangement.

2.4 Backboard Mounted Cable Management

- A. D-Rings
 - 1. Non-conductive, smooth bearing. Available in 2x2, 3x3, 3x5. Size as required for 50 percent spare capacity.
 - 2. Provide on backboards for management of cabling.
- B. Slotted Raceway
 - 1. Provide non-metallic, wall mounted slotted raceway with covers, Available in 2x2/3x3/4x4. Refer to plans for locations. Size as required for 50 percent spare capacity.

PART 3 - EXECUTION

3.1 General Installation

- 1. Refer to drawings for quantity and arrangement of Telecom Room equipment.
- 2. Where cabling is routed along backboards, utilize wall mounted cable management systems to provide cable support at an interval no less than 60 inch O.C.
- 3. Telecommunications Rooms – Provide ladder rack in telecommunications rooms in configurations as indicated on the drawings.

3.2 Telecommunications Rooms

- A. The lay-out of the telecommunications rooms as depicted on the drawings shall be utilized as a general guide for bidding purposes. The final room layout shall be carefully coordinated with

input from the Owner and from other trades with equipment and/or cabinets to be placed in the room. Final configuration of telecom rooms shall be submitted to Engineer as a coordination drawing with information from all other trades occupying the same room for review prior to permanent mounting of equipment or termination of cabling.

- B. Provide ladder rack in telecommunications rooms in configurations as required by final room layout.
 - C. Coordinate layout of telecom rooms to avoid placing telecommunications equipment and cabinets under water piping (other than sprinkler heads) or HVAC units.
 - D. Coordinate layout of telecom rooms with electrical plans and locations of electrical outlets.
 - E. Layout of telecommunications equipment cabinets and racks shall provide a minimum of 36 inch isle in front and behind equipment racks and cabinets which is clear of obstructions or equipment protrusions.
 - F. Within the various telecom rooms, coordinate rack locations and orientation to maintain required clearances including any equipment depths that may have to be accounted for. Some equipment, such as servers and UPS units may have special mounting requirements that need additional coordination.
- 3.3 Grounding – Provide grounding connection of cabinet and cable sleeves to new room telecommunications ground bar.

END OF SECTION

28 31 13 EMERGENCY RESPONDER RADIO COVERAGE SYSTEM (ERRCS)

PART 1 – GENERAL

1.1 Summary

- A. Section includes designing, furnishing, installing, and testing of a complete and operating Emergency Responder Radio Coverage System (ERRCS). These specifications are provided to establish the scope and general operating characteristics of the system.
- B. The function is to provide full building coverage of the local first responders including the Fire Department, Law Enforcement, Emergency Services, etc. in the 800MHz band at the required signal strength.
- C. The ERRCS system shall amplify Emergency Responder radio communications to provide 95% floor area radio coverage within the following areas per Ohio Building Code 915/IFC Section 510:
 - 1) Fire Command Center
 - 2) Security room.
 - 3) Elevators.
 - 4) Elevator lobbies.
 - 5) Emergency and Stand-by Generator Room(s).
 - 6) Fire pump room(s).
 - 7) Areas of refuge.
 - 8) Inside enclosed exit stairways.
 - 9) Exit passageways.
 - 10) Standpipe cabinets.
 - 11) Sprinkler sectional valve locations.
 - 12) Other staging areas identified by the Fire Department.
- D. The ERRCS shall provide monitoring of the essential system components as required by code to include not less than Antenna failure, Booster Failure, AC power supply failure, and system UPS failure.
- E. Final acceptance and approval is required from the Fire Department in writing prior to contract closeout.

1.2 Scope

- A. The system shall include a primary site with donor antenna, BDA and Fiber headend, to be located at the Cole Services Building (CSB).
- B. The system shall distribute service to each of the included remote buildings via the campus fiber optic cabling network as indicated on the drawings.
 - 1) Armstrong Student Center (ASC) including Culler Addition
 - 2) Millett (MIL)
 - 3) Hughes Hall (HUG)
 - 4) Farmer School of Business (FSB)
 - 5) North Parking Garage (NPG)
 - 6) Stonebridge Hall (WRA) – To be served from Fiber Node in Hillcrest
 - 7) Beechwoods Hall (WRB) – To be served from Fiber Node in Hillcrest
 - 8) Hillcrest Hall (WRC)
- C. The existing fiber network shall have selected fiber strands re-terminated in angle polished LC connectors as indicated on the drawings at each end and at each patch point.
- D. The scope includes all fiber jumpers and other connecting cables for a complete and operational system.
- E. The scope includes new power outlets with branch circuitry as indicated on the drawings.
- F. The scope includes all required cabling pathways above accessible ceilings and fixed conduit pathways in exposed areas.

1.3 Radio Information

- A. BRICS is the Butler County simulcast system, which consists of 14 sub-site towers in and around Butler County. This simulcast site (the collection of those 14 towers operating in unison) are attached to the larger State of Ohio MARCS network. When MARCS users roam into Butler County, they use the BRICS simulcast. There are no other MARCS sites in the county.
- B. For the purpose of this project, it should be assumed that Oxford-area / Miami University's talkgroups can only use the Butler County simulcast, due to roaming restrictions. Additional MARCS sites in Preble County should be ignored.
- C. Of the 14 simulcast towers, the three that are most geographically relevant are what are referred to as Collins Run (at the Oxford maintenance garage), Nike (near College Corner) and Roberts (in Collinsville, Milford Township).
 - 1) Collins Run
 - a) FCC 1261630

- b) 945 Collins Run Rd
- c) 39 29 55.2 N, 84 44 26.8 W
- 2) Nike
 - a) FCC 1019227
 - b) 6900 Taylor Road
 - c) 39 33 27.3 N, 84 47 35.5 W
- 3) Roberts
 - a) FCC 1259513
 - b) 5107 Huston Rd
 - c) 39 30 55.5 N, 84 36 40.4 W

D. The Butler County simulcast uses 20 channels. They are:

		Output	Input
1)	Channel 1	853.5375	808.5375
2)	Channel 2	853.2875	808.2875
3)	Channel 3	853.0625	808.0625
4)	Channel 4	853.0375	808.0375
5)	Channel 5	852.6875	807.6875
6)	Channel 6	852.2875	807.2875
7)	Channel 7	852.2000	807.2000
8)	Channel 8	851.7625	806.7625
9)	Channel 9	851.3500	806.3500
10)	Channel 10	851.0375	806.0375
11)	Channel 11	855.9625	810.9625
12)	Channel 12	855.7375	810.7375
13)	Channel 13	855.4875	810.4875
14)	Channel 14	854.9625	809.9625
15)	Channel 15	814.6625	769.6625
16)	Channel 16	857.0875	812.0875

17)	Channel 17	858.1875	813.1875
18)	Channel 18	856.0875	811.0875
19)	Channel 19	859.0875	814.0875
20)	Channel 20	859.2625	814.2625

E. The BRICS simulcast uses all 800MHz channels currently.

1.4 Submittals

- A. Include Cole Services Building (CSB) building elevation depicting the location of outdoor antenna associated with the proposed system. Include height of antenna centerline above building, orientation, and location of all external grounding connections.
- B. Include a plan view of each interior floor where indoor antenna systems are proposed. Include antenna numbers, coaxial cable routes, and the locations of any other system components including splitters, couplers, filters, amplifiers, etc. All components shall be named or labeled for reference in power budget calculations tables. Overlay approximated coverage radii indicating a -95 dBm downlink (base to mobile) signal strength around each proposed indoor coverage antenna. Include results of any previous coverage testing per grid, if available.
- C. Provide schematic diagram of each system including references to submitted equipment.
- D. Specify antenna grounding and surge protection in accordance with NEC Article 810.
- E. Specify the backup power source (Life Safety), and include calculations to ensure the backup power requirements as specified in this standard are met.
- F. Equipment Specification Sheets - Provide copies of manufacturer specification sheets of all system components
- G. Submit product certificates signed by the manufacturer of radio system components certifying that their products comply with specified requirements.

1.5 Quality Assurance

- A. Installer Qualifications: Engage an experienced factory-authorized installer to perform work of this Section.
- B. Single-Source Responsibility: Obtain radio system components from a single source who assumes responsibility for compatibility of system components.
- C. Installation shall conform to the requirements of the NFPA 101, Life Safety Code, the Ohio Basic Building Code, and Local Code and Building Authority requirements.
- D. Comply with NFPA 72, The Ohio Building Code, The Ohio Fire Code, and all local codes.
- E. All equipment shall be UL listed and labeled, and in accordance with applicable NEMA and ANSI Standards.

PART 2 – PRODUCTS

2016-91018

EMERGENCY RESPONDER RADIO COVERAGE SYSTEM (ERRCS)

28 31 13 - 4

2.1 General Performance Requirements

- A. The system design, and installation, shall in no case exceed the FCC's OET 65 Standards "Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields".
- B. Signal Strength
 - 1) Downlink. A minimum signal strength of -95 dBm shall be provided throughout the coverage area.
 - 2) Uplink. A minimum signal strength of -100 dBm received at the City/County/Municipal Radio System from the coverage area.
- C. Permissible Systems
 - 1) The ERRCS system shall utilize a fixed distributed antenna system (DAS) in each coverage building with fiber remote for in-building amplification.
 - 2) The DAS component shall utilize a combination of coaxial trunks/radials and/or fiber trunk/radials with fiber node units.
- D. Supported Frequencies: The radio system shall support simultaneous usage of analog and digital frequencies in the 800 Megahertz public safety bands as utilized by the local Emergency Responder Radio Coverage System.
- E. Reject filters: Notch filter sections shall be incorporated to minimize adjacent channel cellular and SMR (Nextel) degradation of the signal booster performance. The minimum downlink band adjacent band rejection shall be 35 dB or greater at system coverage bands/channels.
- F. Band Migration Capability: The signal booster shall include re-tunable or replaceable filters to accommodate rapid and economic passband changes in the event of mandatory FCC changes within the NPSPAC band. The use of non-adjustable and non-replaceable RF input and output filters is prohibited.
- G. Output Level control: An automatic output leveling circuit shall be included for both passbands with a minimum dynamic range of 60 dB, less any gain reduction setting, to maintain FCC out of band and spurious emission compliance.
- H. Degraded performance in emergencies: The system shall be designed to allow degraded performance in adverse conditions, such as abnormally high temperatures resulting from nearby fires, extreme voltage fluctuations or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) shall not be implemented as the standard mode for public safety applications. It is the purpose of this specification to assure the maximum possible level of communications to public safety personnel depending upon the signal booster even to the extent of damaging the signal booster as long as some communications benefit can be provided during the emergency.
- I. Mode of Operation: The system shall be normally powered on and shall continuously provide passing of frequencies within the Public Safety and First Responder bands.

- J. The system as installed must comply with all applicable sections of FCC Rules Part 22, Part 90 and Part 101.
- K. Active Equipment (Signal Boosters and Bidirectional Amplifiers) Shall meet FCC Requirements.

2.2 Donor Antenna

- A. Antenna - Provide an outdoor rated, YAGI antenna, 746-896MHz, 11dBi, 8 element antenna with hermetically sealed driver unit and stainless steel hardware. Provide antenna with mast mounting hardware.
- B. Mount – Provide a non-penetrating roof mount with concrete block ballasting as required. Provide 2” pipe mast for mounting of antenna. Provide unit with rubber base pad. Coordinate final roof location with existing conditions and verify adequate roof support for load.
- C. Grounding – Ground antenna, mast and roof mount as required by NEC.
- D. Surge Protection – Provide Broadband, bi-directional surge arrestor on antenna lead into system.
- E. Down Conductor – LMR-600, outdoor rated cabling with required connectors and terminations.
- F. Basis of Design – Westell CSI-AY/746-896/11 or Engineer Approved equal.

2.3 BDA

- A. Amplifier - Digital Signal Booster operating in the 800 MHz range (Bid Option for dual band 700/800 MHz) with up to 1-60 programmable digital filters for both uplink and downlink. Filter center frequency and characteristics are fully programmable. Filter bandwidth is user programmable from 6.25 kHz to 15 MHz. All state-of-the-art product components are protected by a NEMA 4 style enclosure to meet the demands of the NFPA requirements. Intuitive web browser interface allows booster to be easily configured for changing RF environments.
 - 1) Channel power shall be as required based upon final system configuration and contractor measured RSSI at donor antenna site.
- B. Power Supplies: At least 2 independent and reliable power supplies shall be provided, one primary and one secondary.
 - 1) The primary power source shall be supplied from a dedicated 20 ampere emergency branch circuit and comply with 4.4.1.4 of NFPA 72.
 - 2) The secondary power source shall be a dedicated battery, capable of operating the ERRCS for at least 12 hours of 100% system operation. The battery cabinet shall be supplied from a dedicated 20 ampere emergency branch circuit and shall automatically charge in the presence of external power input.
- C. Cabinet
 - 1) The signal booster and all associated RF filters shall be housed in a single, NEMA 4x certified, painted steel weather tight box (Color Fire Engine Red). The

cabinet shall be large enough to dissipate internal heat without venting the inside of the cabinet to the outside atmosphere. Operating temperatures: –22 deg F to +120 deg F (–30 deg C to +50 deg C) minimum temperature range, including microprocessors. Provide label on front of cabinet “Emergency Responder Radio System”.

- 2) The battery/charger system and all associated equipment shall be housed in a single, NEMA 4x certified, painted steel weather tight box (Color Fire Engine Red). The cabinet shall be large enough to dissipate internal heat without venting the inside of the cabinet to the outside atmosphere. Operating temperatures: – 22 deg F to +120 deg F (–30 deg C to +50 deg C) minimum temperature range, including microprocessors. Provide label on front of cabinet “Emergency Responder Radio System-Battery Cabinet”.
 - a) Basis of Design – Bird Technologies 6160-H-XX-NG or engineer approved equal.

D. Monitoring

- 1) The ERRCS shall provide the NFPA 72 required minimum alarm supervisory and trouble points including the following:
 - a) Malfunction of the Signal Booster(es)
 - b) Malfunction of the Power Supply(ies)
 - c) Antenna Malfunction
 - d) Low battery capacity (70% of the 12 hour capacity has been depleted)
 - e) Loss of normal AC power
 - f) Failure of battery charger
- 2) The following system trouble/fault conditions shall be annunciated at a minimum:
 - a) Antenna Malfunction
 - b) Signal Booster malfunction
 - c) Low battery capacity of UPS
 - d) Loss of normal AC power
 - e) Loss of emergency AC power (UPS activated)
 - f) AC power supply failure within signal booster assembly.
- 3) Monitoring the integrity of power supplies shall be in accordance with requirements of the local code.
- 4) The system shall have primary fault monitoring through the existing Simplex Fire Alarm System.

- a) Secondary fault monitoring shall be provided by interface with existing ___ Building Automation System.
- 5) The Supervision Alarm(s) shall not be cancelled until the trouble / fault has been corrected and the System has been restored to normal operation.
- E. Basis of Design – Bird Technologies 613-8 series Digital Signal Booster or Engineer Approved Equal.
- F. Provide one (1) complete unit at the Cole Services Building (1) and provide a maintenance/repair kit to be turned over to owner.

2.4 Fiber Headend

- A. Gateway – Provide a rack mounted Base Station Gateway (BGW) which allows control and monitoring of the entire DAS remotely. The unit shall serve a web page, support several VPN tunnels and SNMP Trap alarming.
 - 1) Basis of Design Delta Node BGW or Engineer Approved Equal.
- B. Service Interface Unit
 - 1) Modular chassis mounted Interface Unit (BIU) shall be the RF interface between the Radio Base Station and the Fiber-DAS system. This unit monitors the signal level from the base station and has settable attenuators both in the uplink and downlink paths.
 - 2) The BIU connects to the Point of Interconnect (POI) which distributes the signals over the fiber optic interfaces belonging to the same sector. The unit shall support the following at a minimum:
 - a) Large selection of frequency bands available
 - b) Duplex or non-duplex options
 - c) Radio access technology agnostic
 - d) Multi operaor and multi carrier
 - e) Two seperate RF paths
 - f) Options with high or low input depending on type of BTS
 - g) Test ports for checking signal levels without interrupting service
 - h) Completely software monitored and controlled
 - i) Settable supervision thresholds for high/low operator input signals
 - j) External alarm interface with inputs/outputs
 - k) RoHS Compliant
- C. Fiber Optic Interface

- 1) Modular chassis mounted Fiber Optic Interface (FOI) converts the RF signals into modulated laser light for use on single mode fiber optic links. The unit is ultra-wide band and handles multiple bands or operators as required. The unit shall support the following at a minimum:
 - a) Up to 4 remote units on a single WDM fiber
 - b) Supervision of signal levels and alarms
 - c) A large selection of wavelengths possible
 - d) Ethernet over fiber to remote unit
 - e) Up to 25 km fiber possible
 - f) With or without WDM
 - g) Test ports for uplink and downlink signal monitoring
 - h) RoHS compliant

D. Point of Interconnect Modules

- 1) The Point of Interconnect Unit (POI) is used to interconnect all RF paths in a Fiber-DAS head-end system.
- 2) The unit consists of strips of splitter/combiner ports with one common and multiple isolated ports in each strip.
- 3) The unit is used to interconnect between the base station interface unit and the fiber optic interface and to split the signal on to several fiber-optic interfaces (FOI).
- 4) Provide units in configurations and quantities as required.

E. Chassis

- 1) Provide rack mounted modular chassis with required power supply for SIU, FOI and combiner/splitter network cards.
- 2) Basis of Design – Delta Node or Engineer Approved equal.

F. Power Supply

- 1) Provide rack mounted true-online UPS with supplemental battery packs for 12 hour run-time of Fiber Headend including Gateway and network switch.
- 2) Basis of Design APC SMART On-line UPS with rack mount hardware, battery modules, network monitoring module, and connecting cables, or Engineer Approved equal.

G. Provide one (1) additional Fiber Optic Interface card and turn over to owner.

2.5 Network Switch – Provide layer 2 network switch with 12-10/100 copper ports, copper/fiber gigabit uplink ports, 350w power supply. Provide patching from each FOI and Base Station

Gateway for a complete network solution. Coordinate with M.U for uplink of switch in to MU network and provide programming and IP Addressing as required.

2.6 Fiber Remote

A. High Power fiber remote is a high performing wideband radio head equipped with a linearized multi carrier power amplifier that supports all modulations. The light weight, convection cooled IP65 chassis secures the performance in almost any environment. The unit shall provide the following at a minimum:

- 1) Rugged chassis for use in any environment
- 2) Houses up to two bands or two sectors in the same casing
- 3) Remote control with Ethernet over the fiber optical connection
- 4) Operational parameters are set in a web interface, only a web browser is needed for control
- 5) Wide band amplification
- 6) Supports all modulation schemes including, But not limited to, TETRA/TEDS, GSM, WCDMA, HSPA, LTE, CDMA etc.
- 7) Large range of frequency bands
- 8) Alarms can be forwarded via SNMP to any Maintenance Center
- 9) DHCP client for automatic IP configuration from the BGW
- 10) WDM/CWDM as option
- 11) External alarm in & out
- 12) Diversity as option
- 13) Complies to the RoHS directive 2002-95-EC

B. UPS (Hillcrest only)

- 1) UPS Units - Provide true online battery back-up, power conditioning UPS, floor mounted to serve ERRCS electronics. Unit shall utilize combination of battery and microprocessor regulation to provide protection from brownouts and over voltage. UPS to have the following features at a minimum:
- 2) 1000 VA capacity as indicated on drawings
- 3) Output Operating Range – 120V.
- 4) Communications – Unit shall provide an Ethernet based SNMP management interface, through the LAN to provide remote diagnostics and alarm conditions. Provide vendor management software with all applicable licenses.
- 5) Expandability – Unit shall be provided with additional external battery packs in modules to extend the total unit run-time to a minimum of 12 hours.

6) 1000VA – minimum of four (4) NEMA 5-15R receptacles switched and conditioned. 12 feet line cord with 120V 20A straightblade plug. Final plug configurations shall be coordinated with equipment served. Any accessories or customization of Uninterruptable Power Supply unit shall be the responsibility of the contractor prior to ordering.

7) Unit as manufactured by APC, Liebert, Chloride, or Tripp Lite, Minute Man.

C. Basis of Design Delta Nodes DDH100 with wall mounting hardware.

D. Provide one (1) additional Fiber Remote unit and turn over to owner.

2.7 DAS

A. Interior Antenna

1) Omni-Directional - Wall or ceiling mount, above accessible ceiling, pendant mount in exposed ceiling, Omnidirectional In-building Antenna, 698–960 MHz.

a) Beamwidth, Horizontal 360° omnidirectional

b) Beamwidth, Vertical 80° nominal

c) Gain at Frequency Band 1.5 dBi @ 698–800 MHz

d) Impedance 50 ohm

e) Input Power, maximum 50 W

f) Operating Frequency Band 698 – 800 MHz

g) Polarization Vertical

h) Return Loss 10.9 dB

i) VSWR 1.8:1

j) Plenum rated assembly.

2) Patch-Directional - Directional In-building Antenna, 698–960 MHz, surface wall mounted.

a) Gain, dBi 5.0

b) Beamwidth, Horizontal, degrees 90

c) Beamwidth, Vertical, degrees 65.0

d) VSWR | Return Loss, dB 1.5 | 14.0

e) Input Power per Port, maximum, watts 50

f) Polarization Vertical

g) Impedance 50 ohm

- 3) Provide quantity and locations of antennas as indicated on the drawings.
 - 4) Provide five (5) spare indoor above ceiling antenna units with mounting hardware and turn over to owner.
- B. Cabling
- 1) In-building - AL4RPV50 - HELIAX® Plenum Rated Air Dielectric Coaxial Cable, corrugated aluminum, 1/2 in, off white PVC jacket.
 - 2) Tunnel - AVA5RK-50FX, HELIAX® Coaxial Cable, corrugated copper, 7/8 in, black, Non-halogenated, fire retardant polyolefin jacket.
- C. Connecting Hardware
- 1) L4TNM-PSA, Type N Male Positive Stop™ for 1/2 in AL4RPV50, LDF450A cable
 - 2) 2, 3, and 4-way low power splitters, 698MHz to 2700MHz rated. Loss, tap and isolation values as required by final system configuration.
- D. Passive Equipment: Passband shall be 700/800 Mhz, IP rating of 2 Ghz.
- E. Cable: Passband shall be 700/800 MHZ. All interior Cable shall be rated for fire plenum.
- F. Spare – Provide a total of five (5) additional indoor omni-directional antennas including all costs for installation and 250' of cabling. Units to be placed during construction if required for correction of coverage issues. Antenna units not required after project is complete to be turned over to owner for attic stock.

2.8 Miscellaneous Cabling/Connectivity

- A. Fiber Optic
- 1) Provide re-termination of existing singlemode fiber optic strands with angle polished LC connectors as indicated on the drawings.
 - 2) Provide duplex fiber jumpers, compatible with fiber cable plant and system input/output connectors for a complete and fully operational system.
- B. Copper (data) – Provide CAT 6 data patch cables for all connections of network enabled equipment within the system.
- C. Coaxial – Provide coaxial cable equipment jumpers and connectors required for a complete and fully operational system.

2.9 Licensing

- A. All fees associated with the licensing shall be paid by the Contractor.
- B. All testing must be done on frequencies authorized by the FCC. A valid FCC license will be required if testing is done on frequencies different from the police, fire or emergency medical frequencies.

2.10 Approval and Testing Procedures

- A. Design Approval: Plans shall be submitted and approved prior to installation. The following information shall be provided to the local Fire Department unit representative by the system designer / Contractor:
- 1) A minimum of 3 copies of the RF site survey results and of the proposed solution.
 - 2) A minimum of 3 copies of detailed drawings showing the location of the donor antenna with elevation information, amplification equipment and associated antenna systems which includes a view showing building access to the equipment.
 - 3) A minimum of 3 copies of schematic drawings of the electrical system, backup power, antenna system and any other associated equipment relative to the amplification equipment including panel locations and labeling.
 - 4) A minimum of 1 copy of the Manufacturer's data sheets on all equipment to be installed.
- B. The local Fire Department will review plans and specifications. Upon acceptance, plans will be stamped to indicate approval. Stamped plans are required to be present at the acceptance test. Any field changes that occur during construction shall be incorporated into new As-Built plans, including any manufacturer's data sheets for any equipment changes not submitted in the original submittal. As-Built plans, if required due to system changes, shall be submitted to the local Fire Department for approval.

2.11 Maintenance and Annual Testing

- A. Annual tests will be conducted by the local Fire Department unit or authorized company.
- 1) The 1st year re-testing will be done at no expense to the Owner or the appropriate emergency services departments as required in the original testing procedures.

2.12 Service Contract

- A. Optional Service Contract – The following represents recommendations for a service contract that shall be made available to the owner for purchase outside the scope of this project.
- B. Provide Budgetary pricing to include:
- 1) Upgrades to system as directed by the Fire Department.
 - 2) Maintenance contract with a Radio Service Provider in place with name of authorized company, who will provide a 24 hour by 7 day emergency response within two (2) hours after notification. The system shall be maintained in accordance with FCC requirements.
 - 3) All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radiotelephone Operator License, or a technician certification issued by the Association of Public-Safety Communications Officials International (APCO) or equivalent as determined by the Fire Department.

- 4) Maintain a list of contact personnel with phone numbers at the radio repeater system cabinet. The contact personnel shall have knowledge of the building and the repeater system and be available to respond to the building in the case of an emergency.
- 5) Radio Service Provider maintenance contract shall include but not limited to:
 - a) Annual Test
 - (1) All active components of the distributed antenna system, including but not limited to amplifier, power supplies, and back-up batteries, shall be tested a minimum of once every 12 months.
 - (2) Amplifiers shall be tested to insure that the gain is the same as it was upon initial installation and acceptance. The original gain shall be noted and any change in gain shall be documented.
 - (3) Back-up batteries and power supplies shall be tested under load for a period of 1 hour to verify that they will operate during an actual power outage.
 - (4) Active components shall be checked to determine that they are operating within the manufacturer's specifications for their intended purpose.
 - (5) Documentation of the test shall be maintained on site and a copy forwarded to the Fire Department Radio Supervisor upon completion of the test.
 - b) Five Year Test: In addition to the annual test, a radio coverage test shall be conducted a minimum of once every 5 years to insure that the radio system continues to meet the requirements of this ordinance. The procedure set forth in NFPA 72 shall apply to such tests.
- 6) Fire Department Radio personnel, after providing reasonable notice to the Owner or their representative, shall have the right to enter onto the property to conduct field testing to be certain that the required level of radio coverage is present.

PART 3 – EXECUTION

3.1 General Installation

- A. Install systems in accordance with UL, NEC and all other applicable codes. Install system to comply with drawings and final shop drawings in compliance with manufacturer instructions. Provide all required hardware and labor for rack mounting of head-end system components.
- B. No items of equipment shall be installed in such a manner as to void or reduce the proper operating characteristics of individual components or of the system.
- C. Perform all work under the on site supervision of a factory authorized trained technician. It shall be the responsibility of the technician to check, inspect and adjust this installation to the engineer's and Owner approval. Only factory certified personnel of the installing contractor or manufacturer shall train the Owner's personnel on the proper operation and

maintenance of the equipment. Perform all work in conjunction with this installation in accordance with good engineering practices as established by NEC.

- D. Delivery of all loose equipment which is to be turned over to Owner shall be carefully coordinated and scheduled with Owner prior to shipment

3.2 Installation

- A. ERRCS wiring shall be furnished and installed in accordance with manufacturer's recommendations in compliance with all Local, State and National codes. This contract shall be responsible for designing, furnishing and installing all required cabling between components to form a complete and operational system meeting all the requirements of this specifications.
- B. Provide fire stop material and seal all cable penetrations in the building.
- C. All wiring between devices shall be run open wired above accessible ceilings in cable tray. Where cable tray systems are in place and there is adequate capacity to install the ERRCS wiring, the contractor may utilize these pathways providing they have coordinated with all other wiring contractors on site.
- D. Where pathways do not exist for ERRCS wiring, this contract shall be responsible for providing all required conduit to support communications cabling to meet building codes and manufacturer's recommendations.
- E. Cables shall not be run exposed in any area unless installed in cable tray.
- F. All cabling installed in cable trays in ceiling spaces that are used for air distribution plenums shall be UL plenum rated.
- G. All control and signal cable shall be installed continuous and without splices. Provide appropriate connectors or pre-manufactured cables for each application.
- H. ERRCS System Signal Wires and Cables
 - 1) Wires and cables shall enter each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.
 - 2) Routing and Interconnection
 - a) Wires or cables routed between consoles, cabinets, racks, and other equipment shall be installed in an approved conduit or cable tray that is secured to building structure.
 - b) Completely test all of the cables after installation and replace any that are found to be defective.
 - 3) Install cables without damaging conductors, shield, or jacket.
 - 4) Do not bend cables, while handling or installing, to radii smaller than as recommended by manufacturer.
 - 5) Pull cables without exceeding cable manufacturer's recommended pulling tensions.

- I. Product Delivery, Storage, and Handling
 - 1) Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment model and serial identification numbers.
 - 2) Store and protect equipment in a conditioned space until installation.
- J. System Installation
 - 1) Coaxial antenna cabling shall not be installed in the same conduit, raceway, or cable trays used for other systems.
 - 2) All equipment shall be connected according to the OEM's specifications to ensure correct installation and system performance.
 - 3) Coordinate all roof penetrations with Owner's Roofing Contractor.

3.3 Grounding

- A. Ground cable shields and equipment per Manufacturer's requirements.
- B. Antenna mast shall be grounded per NFPA 70 NEC requirements and antenna manufacturer's requirements. Provide grounding blocks and surge protection for coaxial cabling. Bond antenna mast to lightning protection system.

3.4 Identification/Labeling

- A. All cabling shall be identified at each end indicating its source and destination.
- B. Antennas shall be given unique identification labels that are applied at the unit and recorded in the as-built drawings.

3.5 System Start-UP

- A. System start-up shall be performed by the contractor prior to request for system testing. Start-up shall be coordinated with owner and Sinclair Police in the event that the activation of the new ERRCS introduces unwanted noise or interference to the existing radio systems in the surrounding area.
- B. After completion of the installation, the contractor shall request an initial acceptance test by the Owner and Engineer.

3.6 Testing

- A. Upon completion of the system installation, programming and initial start-up, the contractor shall be responsible for providing performance acceptance testing. This testing shall be scheduled and performed in the presence of the Owner and the Engineer.
- B. All signal measurement acceptance testing shall be performed by the contractor with their own equipment, by qualified personnel who have specific training and familiarization with the test equipment, and with test equipment which have been calibrated within the previous 3 months. Signal measurement results shall be stored electronically and presented with final system documentation including information pertaining to the location of each of the signal measurement tests.

- C. All signal quality and performance acceptance testing shall be performed with local Fire Department radios. Coordinate with the local Fire Department to acquire a test set (properly tuned and calibrated) for use during the acceptance testing.
- D. Tests shall be made using frequencies close to the frequencies used by the Fire Department and appropriate emergency services. If testing is done on the actual frequencies, then this testing must be coordinated with the local Fire Department unit. All testing must be done on frequencies authorized by the FCC. A valid FCC license will be required if testing is done on frequencies different from the police, fire or emergency medical frequencies.
- E. Testing Procedures
 - 1) Measurements shall be made with the antenna held in a vertical position at 3 to 4 feet above the floor to simulate a typical portable radio worn on the belt or turnout coat pocket.
- F. Pre-testing: The radio system shall be pre-tested to ensure that two-way coverage on each floor of the building meets the minimum coverage described above.
- G. Final Acceptance Testing
 - 1) All acceptance testing shall be done in the presence of a Fire Department representative at no expense to the owner/Fire Department.
 - 2) Small scale drawings (11 inch x 17 inch maximum) of the structure shall be provided by the Contractor. The plans shall show each floor divided into the grids as described above, and the results of the pre-testing. Each grid shall be labeled to indicate the DAQ result from the final acceptance testing.
 - 3) The Contractor shall provide the latest approved plans for the system, including any manufacture's data sheets for any equipment changes not submitted in the original submittal.
- H. The ERRCS shall be tested to ensure that the two-way coverage on each floor of the building meets the requirements of the local code and at a minimum covers 95 percent of general building areas and 99% of building Critical Areas. The test procedure shall be conducted as follows:
 - 1) Each floor of the building shall be divided into a grid of 20 approximately equal areas.
 - 2) The test shall be conducted using a calibrated portable of the latest brand and model used by the agency talking through the agency's radio communications system.
 - 3) A maximum of two non adjacent areas shall be allowed to fail the test.
 - 4) In the event that three of the areas fail the test, in order to be more statistically accurate, the floor may be divided into 40 equal areas. A maximum of four nonadjacent areas shall be allowed to fail the test. If the system fails the 40 area test, the system shall be altered to meet the 90-percent coverage requirement.
 - 5) A test location approximately in the center of each grid area shall be selected for the test, then the radio shall be enabled to verify two-way communications to and

from the outside of the building through the public safety agency's radio communications system. Once the test location has been selected, that location shall represent the entire area. If the test fails in the selected test location, that grid area shall fail, and prospecting for a better spot within the grid area shall not be allowed.

- 6) The gain values of all amplifiers shall be measured and the test measurement results shall be kept on file with the building owner so that the measurements can be verified during annual tests. In the event that the measurement results become lost, the building owner shall be required to rerun the acceptance test to re-establish the values.
- 7) As part of the installation a spectrum analyzer or other suitable test equipment shall be utilized to insure spurious oscillations are not being generated by the subject signal booster. This test shall be conducted at the time of installation and subsequent annual inspections.

3.7 Training and Demonstration

- A. Training shall include a complete working demonstration of the ERRCS. Training and Demonstration shall not be executed until after successful system testing as outlined above.
- B. A minimum of eight (8) hours of training shall be included in the contract. Demonstrate purpose, adjustment, operation and maintenance of the system including each component and control.
- C. Review binder containing instructions and equipment and systems data.
- D. Technical training sessions which shall include hands-on training, accompanied by full system documentation and system as-built drawings.
- E. Training shall include any documentation and hands-on exercises necessary to enable operations personnel to assume full operating responsibility of the ERRCS after completion of the training period.

3.8 O&M Manuals and As-Built Drawings

- A. Copies of all approved shop drawings with the Engineer's stamp.
- B. Owner's manuals for every item of equipment when available from the manufacturer. These shall be the technical manuals provided by the manufacturer and shall not consist of generic sales brochures. Technical manuals shall provide complete specifications for the equipment as well as complete operating, maintenance, troubleshooting and product repair/replacement information. Where available only in electronic format, the contractor may provide a CD with electronic versions of Owner's manuals. CDs containing electronic versions of Owner's manuals must contain the proper software viewers for each document type.
- C. Technology drawings updated with final as-Built information. This shall be in the form of a complete set of Technology drawings with as-built information indicated in colored pen based upon actual field conditions. As-built drawings shall include the following"
 - 1) Locations of all active and passive equipment

- 2) Cable routes
 - 3) Location of any “dead spots” as uncovered in the system testing.
- D. System schematic and block diagrams for every system updated with final as-built information. These drawings shall define the exact arrangement of each system including wiring configuration, device locations and cable types and the gain values of all amplifiers.
- E. Warranty: Provide statement of warranty with O&M manuals.

3.9 Warranty

- A. Provide a one (1) year contractors full warranty and complete Service/Maintenance program in compliance with code required system maintenance/service of the system, including equipment, and wiring against defects in material and workmanship from the date of system completion and final acceptance. If any defects in materials, workmanship or operational failures are experienced within the warranty period promptly correct at no extra cost to the Owner for parts or labor. Provide statement of warranty with O & M manuals.
- B. Make available an additional one year service contract offering continuing factory authorized service and code required testing/maintenance of this system after the initial warranty period. Provide estimated cost of this service contract within the proposal.
- C. Contractor shall be responsible to provide service during normal working hours within (8) hours after notification by the Owner for normal service or within (2) hours for emergency service. Emergency service is defined as the loss of any system component inhibiting access to an entire building.
- D. Within the warranty period, if equipment cannot be repaired with 24 hours of service visit, the Contractor shall provide “loaner” equipment to the Owner at no charge.
- E. Proper identification is required and must be visible while on-site for warranty/service calls. Provide notification of completion to the Owner prior to departing the site.

END OF SECTION