SECTION 27 05 11
REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section, Requirements for Communications Installations, applies to all sections of Division 27 and as listed in the Table of Contents.

B. Section 28 05 11, Requirements for Electronic Safety and Security shall be included in and made part of this Section.

C. Furnish and install communications cabling, systems, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of transformers, cable, and other items and arrangements for the specified items are shown on drawings.

1.2 MINIMUM REQUIREMENTS

A. References to industry and trade association standards and codes are minimum installation requirement standards.

B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

C. Where drawings, plans, details, specification requirements and/or scheduled equipment, cabling and raceway capacities are in conflict and shown to be different between plans and/or between plans, riser diagrams, details and specifications, the most stringent requirement will be included in the Contract. Systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and the specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to the Architect’s attention for direction as to what is to be provided.

1.3 QUALIFICATIONS (PRODUCTS AND SERVICES)

A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately five years.
2. The Government reserves the right to require the Contractor to submit a list of installations where the Contractor has installed the products and where the products are currently in operation**,** before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations prior to final acceptance by the SLVHCS.

1.4 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.
2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:

1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the Resident Engineer a minimum of 15 working days prior to the manufacturers making the factory tests.
2. Four copies of certified test reports containing all test data shall be furnished to the Resident Engineer and the project Architect, prior to final inspection and not more than 90 days after completion of the tests.
3. Certified test reports shall be submitted in both hardcopy and electronic copies. Each test report shall identify the device, circuit, cable, panel location and standard test industry pest parameter used in generating the test,
4. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.5 EQUIPMENT REQUIREMENTS

A. Where variations from the contract requirements are requested in accordance with Section 01 00 00, GENERAL REQUIREMENTS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.6 EQUIPMENT PROTECTION

A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:

1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
2. Damaged equipment shall be, as determined by the Resident Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
3. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.7 WORK PERFORMANCE

A. Job site safety and worker safety is the responsibility of the contractor.

B. For work on existing stations, arrange, phase and perform work to assure communications service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.

C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.

D. Coordinate location of equipment and pathways with other trades to minimize interferences. See Section 00 72 00, GENERAL CONDITIONS.

1.8 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Coordinate installation with the Architect and the work of other Trades prior to installation.

C. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
2. " Accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.9 EQUIPMENT IDENTIFICATION

A. Install identification nameplates and labeling which clearly indicates information required for use and maintenance of equipment including but not limited to the following**:**

1. Equipment racks
2. Equipment cabinets

3. Uninterruptible power supply
4. Panels
5. Faceplates
6. Modular jack connectors
7. Cables
8. Conduits and sleeves
9. Telecommunications ground bars and conductors
10. Firestop system certifications

B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item, and are made for integral installation to the installed product or devise or where other method of identification is herein specified, are exceptions as approved in writing by VA prior to installation.

1.10 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage, or installation of equipment or material which has not had prior approval will not be permitted at the job site.

C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings, performance characteristics, wiring diagrams and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify the equipment product number and/or model number being submitted.

D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed.
3. Device and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams for each system.
4. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

F. Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections for each low voltage system, individually. Furnish four copies bound in hardback binders or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:

    a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
    b. A control sequence describing start-up, operation, and shutdown.
    c. Description of the function of each principal item of equipment.
    d. Installation and maintenance instructions.
    e. Safety precautions.
    f. Diagrams and illustrations.
    g. Testing methods.
    h. Performance data and certified acceptance test reports.
    i. Warranty information
    j. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
    k. Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

G. Approvals will be based on complete submission of manuals together with shop drawings.

H. After approval and prior to installation, furnish the Resident Engineer with one sample of each of the following:

1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
2. Each type of conduit and pathway coupling, bushing and termination fitting.
3. Raceway and pathway hangers, clamps and supports.
4. Duct sealing compound.
5. Faceplates and modular jacks for each outlet configuration.
6. Labeling and nomenclature scheme.

    a. In addition to the requirement of SUBMITTALS, the VA reserves the right to request the manufacturer to arrange for a VA representative to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.

1.11 SINGULAR NUMBER

A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.12 TRAINING

A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

B. Training shall be provided for the particular equipment or system as required in each associated specification.

C. A training schedule shall be developed and submitted by the contractor and approved by the Resident Engineer at least 30 days prior to the planned training.

1.13 COORDINATION

A. Where drawings, plans, details, specification requirements and/or scheduled equipment, cabling and raceway capacities are in conflict and shown to be different between plans and/or between plans, riser diagrams, details and specifications, the most stringent requirement will be included in the Contract. Systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and the specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to the Architect’s attention for direction as to what is to be provided.

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SECTION 27 05 11.10
3D BUILDING INFORMATION MODELING

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Common Work Results for HVAC and Steam Generation, Section 23 05 11, Division 25 and other Division 1 Specification Sections, apply to this Section.

B. LEED™ REQUIREMENTS, Refer to Section 018113 – SUSTAINABLE DESIGN REQUIREMENTS

1.2 OVERVIEW

A. Building Information Modeling (BIM) is the development and use of a 3-dimensional computer model to represent a virtual model of the facility and the process for constructing the facility. Once the model is developed, it can be used to simulate the construction process and to manage the operations of the facility. The Building Information Model can be created by combining many different 3D models from the designers and contractors into a composite model. From this composite model, views and data appropriate to various users' needs can be extracted and analyzed to generate information, to make decisions and to improve the process of delivering the building.

1.3 OUTCOME

A. The purpose of BIM is to create a model that may be used for coordination of all trades throughout the construction process, with the final product being an as-built model of the Project which contains all of the major elements of construction that could be used by the Owner for future operation and maintenance of the building.

1.4 REQUIRED DISCLAIMER

A. All users shall be required to sign a disclaimer as follows:

TERMS OF USE OF 3D COMPUTER MODEL FOR THE SLVHCS REPLACEMENT MEDICAL CENTER PROJECT ("Project")

This 3D Computer Model for the Project is provided by NBBJ (Architect) to user (individually, a "User", or collectively, "Users") at the User's request subject to the terms and conditions stated below (the "Terms of Use"):

The 3D Model is made available to User solely for his convenience and for informational purposes only. The User is not to rely upon the 3D Computer Model and the data and/or information contained therein in preparing any of the coordination documents for the Project. The User acknowledges that the 3D Computer Model is not a part of the Construction or Contract Documents for the Project and that the Architect makes no representations or warranties, express or implied, regarding the 3D Computer Model's, accuracy or completeness or the data and/or information contained therein.

By opening the files provided, the User agrees that these terms apply to the 3D Model in its entirety, together with all of its component parts and data The User acknowledges that the requirements of these Terms of Use apply to all of User's principals, employees and agents.

The User agrees that the use of the 3D Computer Model is solely at the User's risk and that the User assumes full responsibility and liability in connection with the User's use of the 3D Computer Model and the information and/or data contained therein. The User agrees that the Architect has no responsibility for any deficiencies, inaccuracies, errors and/or omissions contained in the 3D Computer Model or the data and/or information contained therein. The Architect has no responsibility for any deficiencies or defects in the User's documents, work and/or services resulting from the User's use of the 3D Computer Model in lieu of the Construction and/or Contract Documents for the Project.

The User acknowledges and agrees a) that the use of the 3D Computer Model is not a substitute for professional judgment; b) that the use of the 3D Computer Model does not relieve the User from applying the appropriate standard of care and skill relevant to the use of the 3D Computer Model and its contents; c) that the 3D Computer Model is only to be used as a tool to assist the User in connection with the Project; d) that the User is solely responsible for verifying the accuracy of all results created with the use of the 3D Computer Model; and (e) the Architect is not responsible or liable for the means and methods of construction and the User's use of the 3D Computer Model shall in no way give rise to such responsible or liable by the Architect or its consultants.

THE ARCHITECT AND ITS CONSULTANTS SPECIFICALLY DISCLAIM ALL WARRANTIES WHETHER EXPRESSED, IMPLIED OR STATUTORY, INCLUDING, WITHOUT LIMITATION, ALL WARRANTIES OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE, CONSTRUCTABILITY, NON-INFRINGEMENT, COMPATIBILITY, SECURITY OR ACCURACY AND USERS' USE OF THE 3D COMPUTER MODEL IS AT ITS OWN RISK. USER ASSUMES FULL RESPONSIBILITY AND RISK OF LOSS RESULTING FROM USE OR INABILITY TO USE THE 3D COMPUTER MODEL OR ITS CONTENT.

The User further agrees that the 3D Computer Model contains information that is confidential and proprietary to the Architect, and that the Architect retains the copyright and all other reserved rights in the work product reflected in the 3D Computer Model that was prepared by the Architect or its consultants for the Project. The Architect grants the User a non-exclusive, non-transferable royalty-free license to use the 3D Computer Model for informational purposes only in connection with the Project in strict accordance with these Terms of Use. The User agrees that the 3D Computer Model will be used solely and exclusively for the Project and that it will not use the 3D Computer Model and the data and/or information contained therein, in whole or in part, for any purpose or project other than the Project. The User further agrees that the 3D Computer Model will continue to be kept confidential by the User, and that it shall not be disclosed in any manner, transferred or exchanged to any third parties by the User without the express written consent of the Architect.

Upon completion of the User's involvement with the Project or at any time upon written request of the Architect, the User shall promptly deliver to the Architect the 3D Computer Model and any other material containing or reflecting any information or data in the 3D Computer Model (whether prepared by the Architect, the User or otherwise) and will not retain copies, extracts or other reproductions, tangible or intangible, in whole or in part of the 3D Computer Model. The User's non-disclosure and non-use obligations set forth herein shall survive the return, destruction or deletion of the 3D Computer Model. If the User becomes legally compelled, by subpoena or court order, to disclose the 3D Model, or any information contained therein, the

User shall provide the Architect with prompt notice so that a protective order or other appropriate remedy may be sought by and at the expense of the Architect and/or compliance with the provisions of this Terms of Use may be waived.

User hereby agrees that the Architect shall be entitled to equitable relief, including injunction, in the event of any breach of the Terms of Use, including without limitation its obligations to maintain the confidentiality of the 3D Model, that the granting of such relief will not be opposed and that such relief shall not be the exclusive remedy for such breach. The Architect's failure to insist upon strict adherence to any term of these Terms of Use shall not be considered a waiver thereof or deprive the Architect of the right subsequently to insist upon strict adherence to that term or any other term of this Terms of Use.

The User hereby agrees, to the fullest extent permitted by law, that in no event shall the Architect be liable to User for any damages or losses of any kind including, but not limited to, damages for death or bodily injury to persons, injury to property, and direct, indirect, consequential, special, or incidental damages, resulting from any error, omission, inaccuracy, deficiency or defect in or problem with, the 3D Computer Model or the data and/or information contained therein. Without limiting the foregoing, the User acknowledges that the 3D Computer Model and the data and/or information contained therein may be inaccurate and/or incomplete and that the Architect will have no obligation to update or modify the 3D Computer Model or any of the data and/or information contained in it because the 3D Computer Model was prepared solely for informational purposes and is not part of the Construction or Contract Documents for the Project.

The User agrees that in the event the User, its officers, directors, shareholders, partners, agents, employees, consultants or independent contractors use the 3D Computer Model or the information and/or data contained therein, it shall, to the fullest extent permitted by law, defend, indemnify and hold the Architect and its officers, directors, shareholders, partners, principals, consultants, agents and employees harmless from and against any and all actions, damages, demands, claims, suits, losses, liability, judgments, recoveries, costs and expenses, including, but not limited to, reasonable attorney's fees which any of them may incur in connection with, arising from, resulting from or related to any use of the 3D Computer Model or the data and/or the information contained therein by the User or any third party who receives the 3D Computer Model from the User. Such claims include, without limitation, any claim which may arise due to deletions, omissions or variations of data due to mechanical or technical failure in connection with the transmission of the 3D Computer Model.

The User acknowledges and agrees that it is not in privity of contract with the Architect as of result of these Terms of Use with respect to any claims or causes of action related to or arising out of the Project. The User further agrees to obligate any contractor, consultant or other party who uses the 3D Computer Model to be bound by the terms and conditions contained herein. Any User's use of the 3D Computer Model and the information and/or data contained therein constitutes such User's acceptance of all the terms here specified.

ACCEPTED & AGREED:

Name: _____

Title: _____

Date: _____

1.5 SCOPE OF WORK

A. General Scope Requirements

1. In general, the BIM scope of work for the Project is to create a technically accurate and detailed 3D computer model of the architectural, structural, mechanical, plumbing and electrical systems.
2. The computer model (in plan view) shall extend to five feet beyond the exterior walls of the building. Vertically, the model shall extend from the lowest extent of the foundations up through and including the roof of the top-most floor. To the extent that the scope includes building systems, those systems will be included to the full horizontal and vertical extents of the model including underground utilities and roof mounted items.
3. The level of detail defined in the Specific Scope Requirements is the minimum level of detail required in the model. Greater detail than the minimum should be incorporated into the model where important details are necessary for communicating information about a system.
4. Each Trade Contractor shall provide shop drawings in both 2D and 3D model format.
5. The 3D model shall be located and oriented to the pre-determined world coordinates for the project to allow easy integration into the BIM for the project.
6. The 3D model shall include the project control grid. This grid should be visible when viewing the model in a true view along the X, Y or Z axis.
7. The 3D model shall be layered and constructed in a manner such that all elements of the model can be converted into a 2D dimensioned drawing for use in the field.
8. The 2d shop drawing scale should be 1'-0" = 3/8" unless specified otherwise or as required for full comprehensible and reviewable details.
9. Each drawing should include a key map referencing the location in the building.
10. In addition to the native file format, the Trade Contractor shall provide translation of the 3D model into a .DWG, CIS/2 or other agreed upon file format that can be viewed using NavisWorks Manager.
11. The following changes shall be promptly incorporated into the drawings and model, on a regular basis:

    a. RFIs, Bulletins and Owner changes
    b. Changes in the sequence of work
    c. Field modifications
    d. Shop drawing review comments
    e. Changes requested by the Construction Manager

12. All revised 3d model or 2D drawing submittals shall have a written narrative to define changes from previous submittals. Typical drafting techniques such as 'clouds' or 'bubbles' are acceptable means of tracking changes on the 2D drawings. [Layer control shall be used to define changes in the 3D model. All revisions shall be shown in both 2D and 3D formats].
13. The working 3D model will be shared with the Trade Contractors and design team at least once every two weeks. This will be performed by posting the model to the project FTP site or PrologWeb. The Trade Contractor will post the native file format and an agreed upon file format as defined in Item 10 above.
14. Pre-detailing meeting:

    a. Shall determine the lead trade.
    b. The order that coordination work will be added to the model.

15. The 3D modeling and layering conventions will be established at a pre-detailing meeting to be attended by:

    a. Concrete Contractor and detailer
    b. Steel Fabricator and detailer
    c. Mechanical Contractors and detailers
    d. Electrical Contractors and detailers
    e. Plumbing Contractors and detailers
    f. Fire protection Contractors and detailers
    g. Other trades.

16. Each Trade Contractor will submit its 3D modeling software and proposed file format(s) for approval prior to proceeding with detailing. The Trade Contractor will also provide a 3D mock-up of a specific portion of the project, to be agreed upon at a future time, in full detail in order to verify the compatibility of the file formats.
17. Each Trade Contractor shall provide viewer licenses only for its specific 3D software to the following:

    a. Owner
    b. Construction Manager
    c. Architect
    d. Engineer of Record

18. Each Trade Contractor and detailers shall have the capability to host and attend web meeting using Microsoft Live Meeting software.
19. Each Trade Contractor shall complete the drawings and model in a time frame capable of meeting the Project Schedule.
20. The Trade Contractors are advised that the model shall be shared among all trades and shall be the basis of coordination and fabrication. Costs incurred for post-coordination changes caused by unauthorized deviations from the model shall be borne by the Trade Contractor that initially deviated from the model. This determination is at the sole discretion of the Construction Manager.
21. The base architectural BIM will be created using AutoDesk's Revit Building.
22. The 3D modeling effort is intended to augment and assist in the MEP coordination process. Before first submission shop drawings, the elements shall be first pass coordinated in the 3D model. The model is intended to find conflicts before shop drawings are reviewed and approved.
23. In addition to the requirements set forth in the contract documents, final models shall be submitted reflecting true "as-built" conditions.

B. Plumbing Technical Scope Requirements

1. All plumbing piping will be modeled. All plumbing equipment will be modeled to its overall height, width and depth. Pipes will be modeled to the outside diameter of the pipe or the pipe insulation, whichever is greater. Pipe slope will be incorporated in the model.
2. Pipe fittings and connections will not be modeled. All valves, clean outs and accessories will be modeled.
3. Each Trade Contractor to provide a list of minimum typical clearances for all model components and coordinate necessary clearances within the model. The 3D model is to include clearances for equipment – included as a modeled volume such that clash detection and coordination can be accommodated relating to necessary clearances.
4. Each Trade Contractor shall be prepared to attend weekly coordination meetings to resolve conflicts within the model.

5. The 3D models submitted by the Trade Contractor for overall coordination are required to be checked and coordinated with the structure and the Trade Contractor's own work prior to submittal.
6. The 3D model is to include access areas for equipment – included as a modeled element such that clash detection and coordination can be accommodated relating to access.
7. Coordinated model data is to be distributed weekly and 1 day prior to coordination meetings.
8. Penetrations through building systems shall be identified in the 3D model by means of a modeled sleeve.
9. All items modeled shall have a level of intelligence associated with them, including, at a minimum, material type, size, insulation, etc.
10. All items located within mechanical rooms shall have a level of intelligence associated with them that includes, at a minimum, material type, size, insulation, manufacturer, product numbers, serial numbers, maintenance schedules, operation and maintenance data, etc.

C. Electrical Technical Scope Requirements

1. All electrical equipment including switchgear, transformers and panelboards will be modeled to its overall size. All necessary clearances for electrical equipment will be modeled as a separate volume. All conduit 1-1/2" and larger shall be modeled.
2. All light fixtures will be modeled as an overall volume require for that fixture.
3. Each Trade Contractor shall provide a list of minimum typical clearances for all model components and coordinate necessary clearances within the model. The 3D model is to include clearances for equipment – included as a modeled volume such that clash detection and coordination can be accommodated relating to necessary clearances.
4. Each Trade Contractor shall be prepared to attend weekly coordination meetings to resolve conflicts within the model.
5. The 3D models submitted by the Trade Contractor for overall coordination are required to be checked and coordinated with the structure and the Trade Contractor's own work prior to submittal.
6. The 3D model is to include access areas for equipment – included as a modeled element such that clash detection and coordination can be accommodated relating to access.
7. Coordinated model data is to be distributed weekly and 1 day prior to coordination meetings.
8. Penetrations through building systems shall be identified in the 3D model by means of a modeled sleeve.
9. All panelboards modeled shall have a level of intelligence associated with them that accurately identifies at a minimum the panel schedule.
10. All items located within electrical rooms and closets shall have a level of intelligence associated with them that includes, at a minimum, material type, size, manufacturer, product numbers, serial numbers, maintenance schedules, operation and maintenance data, etc.

D. Fire Protection Technical Scope Requirements

1. All fire protection equipment including pipe, valves, heads, risers and drains will be modeled.
2. Each Trade Contractor to provide a list of minimum typical clearances for all model components and coordinate necessary clearances within the model. The 3D model is to include clearances for equipment – included as a modeled volume such that clash detection and coordination can be accommodated relating to necessary clearances.
3. This Trade Contractor shall be prepared to attend weekly coordination meetings to resolve conflicts within the model.

4. The 3D models submitted by the Trade Contractor for overall coordination are required to be checked and coordinated with the structure and the Trade Contractor's own work prior to submittal.
5. Coordinated model data is to be distributed weekly and 1 day prior to coordination meetings.
6. Penetrations through building systems shall be identified in the 3D model by means of a modeled sleeve.
7. All items modeled shall have a level of intelligence associated with them that accurately identifies at a minimum the material type, rating, model number, etc.

E. Mechanical / Sheetmetal Technical Scope Requirements

1. All ducts and air handling equipment will be modeled. Ducts will be modeled to the outside face dimension. Equipment will be modeled to its overall height, width and depth. All piping associated with the mechanical system will be modeled. Pipes will be modeled to the outside diameter of the pipe or pipe insulation (whichever is greater).
2. Pipe hangers and hanger assemblies and dunnage will be modeled for clash detection and coordination. Fittings and connections will not be modeled. The intent of this model is to show the ductwork and piping, etc. in a true representation of the actual condition at construction completion.
3. Pipe fittings and connections will not be modeled. All valves, clean outs and accessories will be modeled.
4. Each Trade Contractor to provide a list of minimum typical clearances for all model components and coordinate necessary clearances within the model. The 3D model is to include clearances for equipment – included as a modeled volume such that clash detection and coordination can be accommodated relating to necessary clearances.
5. Each Trade Contractor shall be prepared to attend weekly coordination meetings to resolve conflicts within the model.
6. The 3D models submitted by the Trade Contractor for overall coordination are required to be checked and coordinated with the structure and the Trade Contractor's own work prior to submittal.
7. The 3D model is to include access areas for equipment – included as a modeled element such that clash detection and coordination can be accommodated relating to access.
8. Coordinated model data is to be distributed weekly and 1 day prior to coordination meetings.
9. Penetrations through building systems shall be identified in the 3D model by means of a modeled sleeve.
10. All items modeled shall have a level of intelligence associated with them including, at a minimum, the material type, size, insulation, etc.
11. Each Trade Contractor shall include in their base bid BIM/Coordination facilities on site. The Construction Manager shall provide a Coordination Trailer for the Construction Team's use throughout the duration of the project. The HVAC Trade Contractor must provide a CAD workstation capable of running the Trade Contractor's CAD software as well as the following BIM software:

    a. NavisWorks Manager (current version)
    b. AutoCAD Revit Architecture Suite (current version)
    c. AutoCAD Revit MEP Suite (current version)

12. Each Trade Contractor shall turn over the above software complete with Licenses at Final Completion for the Owner's use.

F. Telecommunications Technical Scope Requirements

1. All telecommunications equipment including racks, cabinets, pa speakers, data outlets and patch panels will be modeled to its overall size. All necessary clearances for telecommunication equipment will be modeled as a separate volume. All conduit 1-1/2" and larger shall be modeled.
2. Each Trade Contractor shall provide a list of minimum typical clearances for all model components and coordinate necessary clearances within the model. The 3D model is to include clearances for equipment – included as a modeled volume such that clash detection and coordination can be accommodated relating to necessary clearances.
3. Each Trade Contractor shall be prepared to attend weekly coordination meetings to resolve conflicts within the model.
4. The 3D models submitted by the Trade Contractor for overall coordination are required to be checked and coordinated with the structure and the Trade Contractor's own work prior to submittal.
5. The 3D model is to include access areas for equipment – included as a modeled element such that clash detection and coordination can be accommodated relating to access.
6. Coordinated model data is to be distributed weekly and 1 day prior to coordination meetings.
7. Penetrations through building systems shall be identified in the 3D model by means of a modeled sleeve.
8. All communication outlets on the plans shall have a level of intelligence associated with them that accurately identifies at a minimum the number of patch panels required.
9. All items located within TR rooms shall have a level of intelligence associated with them that includes, at a minimum, material type, size, manufacturer, product numbers, serial numbers, maintenance schedules, operation and maintenance data, etc.

G. Security Technical Scope Requirements

1. All security equipment including racks, patch panels, CCTV cameras, emergency phones and card readers will be modeled to its overall size. All necessary clearances for telecommunication equipment will be modeled as a separate volume. All conduit 1-1/2" and larger shall be modeled.
2. Each Trade Contractor shall provide a list of minimum typical clearances for all model components and coordinate necessary clearances within the model. The 3D model is to include clearances for equipment – included as a modeled volume such that clash detection and coordination can be accommodated relating to necessary clearances.
3. Each Trade Contractor shall be prepared to attend weekly coordination meetings to resolve conflicts within the model.
4. The 3D models submitted by the Trade Contractor for overall coordination are required to be checked and coordinated with the structure and the Trade Contractor's own work prior to submittal.
5. The 3D model is to include access areas for equipment – included as a modeled element such that clash detection and coordination can be accommodated relating to access.
6. Coordinated model data is to be distributed weekly and 1 day prior to coordination meetings.
7. Penetrations through building systems shall be identified in the 3D model by means of a modeled sleeve.
8. All security devices on the plans shall have a level of intelligence associated with them that accurately identifies at a minimum the number of patch panels and number of data gathering panels required.

9. All items located within LVSR rooms shall have a level of intelligence associated with them that includes, at a minimum, material type, size, manufacturer, product numbers, serial numbers, maintenance schedules, operation and maintenance data, etc.

- - - END - - -

SECTION 27 05 26
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies general grounding and bonding requirements of telecommunication installations for equipment operations.

B. “Grounding electrode system” refers to an electrode(s) as specified in the National Electrical Code, Article 250. C. The terms “connect” and “bond” are used interchangeably in this specification and shall mean “the permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to conduct safely any current likely to be imposed.

C. The term “effectively grounded” shall mean intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to prevent the buildup of voltages that may result in undue hazard to connected equipment or persons.

D. The term “grounding electrode conductor” shall refer to the conductor used to connect the grounding electrode to the equipment grounding conductor, to the grounded conductor, or to both, of the circuit at the service equipment, or at the source of a separately derived system.

E. The term “grounding equalizer” shall refer to the conductor that interconnects elements of the telecommunications grounding infrastructure.

F. The term “telecommunications bonding backbone” or “TBB” shall refer to a conductor of appropriate size that interconnects the telecommunications main grounding busbar (TMGB) to the telecommunications grounding busbar (TGB).

1.2 RELATED WORK

A. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 27.

B. Section 27 10 00, STRUCTURED CABLING:.

C. Section 26 41 00, FACILITY LIGHTNING PROTECTION: Requirements for a lightning protection system.

1.3 SUBMITTALS

A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
3. Documentation that all grounding and bonding connectors are listed by a nationally recognized testing laboratory (NRTL).

C. Test Reports: Provide certified test reports of ground resistance.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Architect and the Resident Engineer:

1. Certification that the materials and installation is in accordance with the drawings and specifications.
2. Certification, by the Contractor, that the complete installation has been properly installed labeled and tested.

1.4 APPLICABLE PUBLICATIONS

Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

A. American Society for Testing and Materials (ASTM):

1.	B1-2001	Standard Specification for Hard-Drawn Copper Wire
2.	B8-2004	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
3.	B258-01	Standard Specifications for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors

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

1.	81-1983	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
2.	IEEE 1100	Powering and Grounding Sensitive Electronic Equipment

C. National Fire Protection Association (NFPA):

1. ANSI/NFPA-70 National Electrical Code (NEC)

D. Telecommunications Industry Association, (TIA)

1. ANSI-J-STD-607-A-2002 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

E. Underwriters Laboratories, Inc. (UL):

1.	44-2005	Thermoset-Insulated Wires and Cables
2.	83-2003	Thermoplastic-Insulated Wires and Cables
3.	467-2004	Grounding and Bonding Equipment
4.	486A-486B-2003	Wire Connectors

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.

B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

C. Isolated Power System: Type XHHW-2 insulation with a dielectric constant of 3.5 or less.

D. Telecom System Grounding Riser Conductor: Telecommunications Grounding Riser shall be in accordance with J STD-607A. Use a minimum 50mm² (1/0 AWG) insulated stranded copper grounding conductor and Telecommunications Bonding Backbone unless indicated otherwise.

2.2 GROUND RODS

A. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.

B. Quantity of rods shall be as required to obtain the specified ground resistance.

C. The connection of the ground rod to the building electrical grounding electrode shall be accomplished using exothermic welding.

2.3 SPLICES AND TERMINATION COMPONENTS

A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

B. Splices shall not be permitted within TBB or grounding electrode conductor segments. Where splicing is proven necessary, the number of splices shall be at a minimum. The joining of segments shall be connected via exothermic welding or approved irreversible compression-type connectors and such connections shall be accessible and located within telecommunications spaces.

2.4 TELECOMMUNICATION SYSTEM GROUND BUSBARS

A. Provide solid copper electrotin plated busbar, pre-drilled for two-hole standard size lug connections with a minimum thickness of 6 mm (1/4 inch) for wall and backboard mounting using standard insulators sized as follows:

1. Telecommunications Grounding Busbar (TGB) : 300 mm x 100 mm (12 inches x 4 inch).
2. Telecommunications Main Grounding Busbar : 600 mm x 100 mm (24 inches x 4 inch).

2.5 GROUND CONNECTIONS

A. Below Grade: Exothermic-welded type connectors.

B. Above Grade:

1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
2. Ground Busbars: Listed Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
3. Rack and Cabinet Ground Bars: one-hole, non-twisting compression-type lugs using zinc-plated or copper alloy fasteners.

C. Cable Shields: Make ground connections to multipair communications cables with metallic shields using shield bonding connectors with screw stud connection.

2.6 EQUIPMENT RACK AND CABINET GROUND BARS

A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x ¾ inch).

2.7 GROUND TERMINAL BLOCKS

A. At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.8 SPLICE CASE GROUND ACCESSORIES

A. Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm² (6 AWG) insulated ground wire with shield bonding connectors.

PART 3 - EXECUTION

3.1 GENERAL

A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.

B. System Grounding:

1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
3. Isolation transformers and isolated power systems shall not be system grounded.

C. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

A. Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.3 SECONDARY EQUIPMENT AND CIRCUITS

A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.

B. Metallic Piping, Building Steel, and Supplemental Electrode(s):

1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to UL 467.
2. Provide a supplemental ground electrode and bond to the grounding electrode system.

C. Conduit Systems:

1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
2. Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.

D. Boxes, Cabinets and Enclosures

1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

3.4 CORROSION INHIBITORS

A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.5 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.6 TELECOMMUNICATIONS SYSTEM

A. Bond telecommunications system grounding equipment to the electrical grounding electrode system.

B. Furnish and install all wire and hardware required to properly ground, bond and connect communications raceway, cable tray, metallic cable shields, and equipment to a ground source.

C. Ground bonding jumpers shall be continuous with no splices. Use the shortest length of bonding jumper possible.

D. Provide ground paths that are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milli ohms or less.

E. Below-Grade Grounding Connections: When making exothermic welds, wire brush or file the point of contact to a bare metal surface. Use exothermic welding cartridges and molds in accordance with the manufacturer's recommendations. After welds have been made and cooled, brush slag from the weld area and thoroughly cleaned the joint area. Notify the Resident Engineer prior to backfilling any ground connections.

F. Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.

G. Bonding Jumpers:

1. Use insulated ground wire of the size and type shown on the Drawings or use a minimum of 16 mm² (6 AWG) insulated copper wire.
2. Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
3. Use compression connectors of proper size for conductors specified. Use connector manufacturer's compression tool.

H. Bonding Jumper Fasteners:

1. Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping the plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.
2. Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover, e.g., zinc-plated acorn nuts on any bolts extending into wireway or cable tray to prevent cable damage.
3. Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.
4. Unistrut and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.

3.7 COMMUNICATION ROOM GROUNDING

A. Telecommunications Ground Busbars:

1. Provide communications room telecommunications ground busbar hardware at 950 mm (18 inches) at locations indicated on the Drawings.

2. Connect the telecommunications room ground busbars to other room grounding busbars as indicated on the Grounding Riser diagram.

B. Telephone-Type Cable Rack Systems: aluminum pan installed on telephone-type cable rack serves as the primary ground conductor within the communications room. Make ground connections by installing the following bonding jumpers:

1. Install a 16 mm² (6 AWG) bonding between the telecommunications ground busbar and the nearest access to the aluminum pan installed on the cable rack.
2. Use 16 mm² (6 AWG) bonding jumpers across aluminum pan junctions.

C. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:

1. When ground bars are provided at the rear of lineup of bolted together equipment racks, bond the copper ground bars together using solid copper splice plates supplied by the ground bar manufacturer.
2. Bond together nonadjacent ground bars on equipment racks and cabinets with 16 mm² (6 AWG) insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.
3. Provide a 16 mm² (6 AWG) bonding jumper between the rack and/or cabinet ground busbar and the aluminum pan of an overhead cable tray or the raised floor stringer as appropriate.

D. Backboards: Provide a screw lug-type terminal block or drilled and tapped copper strip near the top of backboards used for communications cross-connect systems. Connect backboard ground terminals to the aluminum pan in the telephone-type cable tray using an insulated 16 mm² (16 AWG) bonding jumper.

E. Other Communication Room Ground Systems:

1. Ground all metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to the cable tray pan or the telecommunications ground busbar, whichever is closer, using insulated 16 mm² (6 AWG) ground wire bonding jumpers.
2. Each TGB and TMGB shall be bonded to the vertical structural steel frame using a minimum #6 AWG insulated ground conductor.
3. Where antenna cables enter the building, the point of entry shall be treated as en entrance facility and a TGB shall be provided within a NEMA 4X rated pull box enclosure at the point of entry.

3.8 COMMUNICATIONS CABLE GROUNDING

A. Bond all metallic cable shields in multipair communications cables together at each splicing and/or terminating location to provide 100 percent metallic shield continuity throughout the communications distribution system.

1. At terminal points, install a cable shield bonding connector provide a screw stud connection for ground wire. Use a bonding jumper to connect the cable shield connector the TMGB or the TGB with telecommunications or low voltage systems rooms.
2. Bond all metallic cable shields together within splice closures using cable shield bonding connectors or the splice case grounding and bonding accessories provided by the splice case manufacturer. When an external ground connection is provided as part of splice closure, connect to an approved ground source and all other metallic components and equipment at that location.

3.9 COMMUNICATIONS CABLE TRAY SYSTEMS:

A. Bond the metallic structures of one cable tray in each tray run following the same path to provide 100 percent electrical continuity throughout the cable tray systems as follows:

1. Splice plates provided by the cable tray manufacturer can be used for providing a ground bonding connection between cable tray sections when the resistance across a bolted connection is 10 milliohms or less. The Subcontractor shall verify this loss by testing across one slice plate connection in the presence of the Contractor.
2. Install a 16 mm² (6 AWG) bonding jumper across each cable tray splice or junction where splice plates cannot be used.
3. When cable tray terminations to cable rack, install 16 mm² (6 AWG) bonding jumper between cable tray and cable rank pan.

3.10 COMMUNCIATIONS RACEWAY GROUNDING

A. Conduit: Use insulated 16 mm² (6 AWG) bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.

B. Wireway: use insulated 16 mm² (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and across all section junctions.

C. Cable Tray Systems: Use insulated 16 mm² (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 16 meters (50 feet).

3.11 GROUND RESISTANCE

A. Grounding system resistance to ground shall not exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Government. Final tests shall assure that this requirement is met.

B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

C. Services at power company interface points shall comply with the power company ground resistance requirements.

D. Below-grade connections shall be visually inspected by the Resident Engineer prior to backfilling. The Contractor shall notify the Resident Engineer 24 hours before the connections are ready for inspection.

3.12 GROUND ROD INSTALLATION

A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.

B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.

C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

- - - E N D - - -

SECTION 27 05 33
RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, raceway systems. Raceways are required for all communications cabling unless shown or specified otherwise.

B. Definitions:

1. The term conduit, as used in this specification, shall mean any or all of the raceway types specified and having a circular cross-section.
2. The term “raceway” shall mean any enclosed channel designed for holding wires or cables.
3. The terms “outlet box”, “pull box” and “junction box” shall refer to an accessible metallic device box mounted within a wall, floor or ceiling and used to hold telecommunications outlets/connectors, transition devices or cabling.
4. The terms “pullcord”, “pullwire”, “pull tape” and “fish tape” shall refer to a cord or wire placed within a raceway or conduit and used to pull wire and cable through the raceway or conduit.
5. The term “pathway” as used herein refers to a facility for the placement of telecommunications cable, conduit or raceway.

1.2 RELATED WORK

A. Bedding of conduits: Section 03 20 00, EARTH MOVING.

B. Mounting board for communication closets: Section 06 10 00, ROUGH CARPENTRY.

C. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.

D. Fabrications for the deflection of water away from the building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

E. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: Section 07 92 00, JOINT SEALANTS.

F. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.

G. General electrical requirements and items that is common to more than one section of Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

H. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

1.3 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

1. Shop Drawings:

a. Size and location of panels and pull boxes
b. Layout of required conduit penetrations through structural elements.
c. The specific item proposed and its area of application shall be identified on the catalog cuts.

2. Certification: Prior to final inspection, deliver to the Architect and Resident Engineer four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

1.4 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. National Fire Protection Association (NFPA):

1.	70	National Electrical Code (NEC)

C. Underwriters Laboratories, Inc. (UL):

1.	1-03	Flexible Metal Conduit
2.	5-01	Surface Metal Raceway and Fittings
3.	6-03	Rigid Metal Conduit
4.	50-03	Enclosures for Electrical Equipment
5.	263	Fire Tests of Building Construction and Materials
6.	360-03	Liquid-Tight Flexible Steel Conduit
7.	467-01	Grounding and Bonding Equipment
8.	514A-01	Metallic Outlet Boxes
9.	514B-02	Fittings for Cable and Conduit
10.	514C-05	Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
11.	651-02	Schedule 40 and 80 Rigid PVC Conduit
12.	651A-03	Type EB and A Rigid PVC Conduit and HDPE Conduit
13.	797-03	Electrical Metallic Tubing
14.	1242-00	Intermediate Metal Conduit

D. National Electrical Manufacturers Association (NEMA):

1.	TC-3-04	PVC Fittings for Use with Rigid PVC Conduit and Tubing
2.	FB1-03	Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
3.	NEMA OS 1	Sheet Steel Outlet Boxes, Device Boxes, Covers and Box Supports

PART 2 – PRODUCTS

2.1 MATERIAL

A. Conduit Size: In accordance with the NEC, but not less than 27 mm (1-inch) unless otherwise shown.

B. Conduit:

1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
2. Rigid aluminum: Shall Conform to UL 6A, ANSI C80.5.
3. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
4. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
5. Flexible galvanized steel conduit: Shall Conform to UL 1.
6. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
7. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
8. Surface metal raceway: Shall Conform to UL 5.

C. Conduit Fittings:

1. Rigid Steel and IMC Conduit Fittings:

a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
b. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
d. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
e. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
f. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.

2. Rigid Aluminum Conduit Fittings:

a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
b. Locknuts and bushings: As specified for rigid steel and IMC conduit.
c. Set screw fittings: Not permitted for use with aluminum conduit.

3. Electrical Metallic Tubing Fittings:

    a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
    b. Only steel or malleable iron materials are acceptable.
    c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
    d. Indent type connectors or couplings are prohibited.
    e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.

4. Flexible Steel Conduit Fittings:

    a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
    b. Clamp type, with insulated throat.

5. Liquid-tight Flexible Metal Conduit Fittings:

    a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
    b. Only steel or malleable iron materials are acceptable.
    c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.

6. Direct Burial Plastic Conduit Fittings:

    a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
    b. As recommended by the conduit manufacturer.

7. Surface metal raceway fittings: As recommended by the raceway manufacturer.
8. Expansion and deflection couplings:

    a. Conform to UL 467 and UL 514B.
    b. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
    c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
    d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

D. Conduit Supports:

1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
3. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

E. Outlet, Junction, and Pull Boxes:

1. UL-50 and UL-514A.
2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
4. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.
5. Communication system pull boxes shall be sized per installation detail number three on Sheet TN003.

F. Wireways: Equip with hinged covers, except where removable covers are shown.

G. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters, and imprinted with “CAUTION BURIED COMMUNICATIONS CABLE BELOW”.

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:

1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the Architect and Resident Engineer prior to drilling through structural sections.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Architect and Resident Engineer as required by limited working space.

B. Fire Stop: Where conduits, wireways, and other communications raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.

C. All openings in firerated walls shall be firestopped, smoke proofed and sealed tight with a listed and FM approved qualified system.

D. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS.

3.2 INSTALLATION, GENERAL

A. Install conduit as follows:

1. In complete runs before pulling in cables or wires.
2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.

4. Cut conduits and raceway ends neat and square. Ream ends, remove burrs, and draw up tight.
5. Mechanically continuous.
6. Independently support conduit at 8’-0” on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
9. Conduit installations under fume and vent hoods are prohibited.
10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
11. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
12. Do not use aluminum conduits in wet locations.
13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

B. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.
4. Conduit and raceway entering communications or low voltage systems rooms via the ceiling/overhead shall be a minimum of 8’-6” high and extend to within the interior of the room a minimum of 3-inches before any bends are applied.

C. Layout and Homeruns:

1. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COTR. Provide the proposed deviation for approval to Architect and Engineer and Resident Engineer.

3.3 CONCEALED WORK INSTALLATION

A. In Concrete:

1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only when the following occurs:

    a. Where shown on the structural drawings.
    b. As approved by the Resident Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.

4. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.

    a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
    b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.

c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.

5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

B. Furred or Suspended Ceilings and in Walls:

1. Conduit for conductors 600 volts and below:

a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.

2. Align and run conduit parallel or perpendicular to the building lines.
3. Tightening set screws with pliers is prohibited.

3.4 EXPOSED WORK INSTALLATION

A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.

B. Electrical Metallic Tubing (EMT)

1. EMT shall be permitted for both exposed and concealed work.
2. EMT shall not be permitted:

a. Where subject to physical damage, including mechanical equipment rooms below 10’-0” AFF.
b. In corrosive areas.
c. In cinder block construction.
d. In hazardous (classified) locations.
e. Within parking garages.
f. Within utility tunnels
g. On building roofs
h. Outside of building

C. Conduit for Conductors 600 volts and below:

1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.

D. Align and run conduit parallel or perpendicular to the building lines.

E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.

F. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.

G. Surface metal raceways: Use only where shown.

H. Painting:

1. Paint exposed conduit as specified in Section09 91 00, PAINTING.

2. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

3.5 EXPANSION JOINTS

A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.

B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.

C. Install expansion and deflection couplings where shown.

D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.

3.6 CONDUIT SUPPORTS, INSTALLATION

A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.

B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.

C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.

D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.

E. Fasteners and Supports in Solid Masonry and Concrete:

1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
2. Existing Construction:

    a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
    b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
    c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts are permitted.

G. Bolts supported only by plaster or gypsum wallboard are not acceptable.

H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.

L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.7 BOX INSTALLATION

A. Boxes for Concealed Conduits:

1. Flush mounted.
2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.

C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

D. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".

3.8 COMMUNICATION SYSTEM CONDUIT

A. Install the communication raceway system as shown on drawings.

B. Minimum conduit size of 27 mm (1-inch) but not less than the size shown on the drawings.

C. All conduit ends shall be threaded and equipped with insulated, threaded bushings.

D. A pull or splice box shall be placed in a conduit run where:

1. The conduit length is over 100 feet
2. There are more than two (2) 90 degree bends, or equivalent
3. There is a reverse or U-shaped bend in the run

E. Vertical conduit sleeves through telecommunications and low voltage systems rooms shall terminate not less than 75 mm (3 inches) below the floor and not less than 75 mm (3 inches) below the ceiling of the floor below.

F. Terminate conduit runs to/from a backboard in a closet or interstitial space at the top or bottom of the backboard. Conduits shall enter communication closets next to the wall and be flush with the backboard.

G. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams, and obtain pror approval from Architect and Structural Engineer.

H. All empty conduits located in communication closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.

I. Conduit runs shall contain no more than two (2)- 90 degree bends or equivalent between pull boxes. Minimum inside radius of communication conduit bends shall be as follows (special long radius):

Sizes of Conduit Trade Size	Radius of Conduit Bends In Inches
1	6-inches
1-1/4	7.5-inches
1-1/2	9-inches
2	20-inches
2-1/2	25-inches
3	30-inches
3-1/2	35-inches
4	40-inches

J. Furnish and install 19 mm (3/4 inch) thick fire retardant plywood specified in Section 06 10 00, ROUGH CARPENTRY on the wall of communication closets where shown on drawings . Mount the plywood with the bottom edge 300 mm (one foot) above the finished floor.

K. Furnish and pull wire in all empty conduits. (Sleeves through floor are exceptions).

L. All conduits and sleeves shall be labeled in accordance with ANSI/TIA/EIA-606A.

M. Any single run of conduit extending from a telecommunications or low voltage systems room shall not serve more than two (2) outlet boxes.

1. Conduits serving two outlet boxes shall be incrementally increased in size from the furthest outlet box to the telecommunications or low voltage systems room.

N. Where a 1-inch or 1-1/4-inch trade sized conduit is required, a 4-11/16inch x 4-11/16inch x 2-1/2inch outlet device box shall be utilized

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SECTION 27 10 00
STRUCTURED CABLING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of the structured cabling system to provide a comprehensive telecommunications infrastructure.

1.2 RELATED WORK

A. Excavation and backfill for cables that are installed in conduit: Section 03 20 00, EARTH MOVING.

B. Sealing around penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.

C. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

D. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.

E. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

1.3 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

1. Manufacturer's Literature and Data: Showing each cable type and rating.
2. Certificates: Two weeks prior to final inspection, deliver to the Resident Engineer four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

1.4 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.

B. American Society of Testing Material (ASTM):
D2301-04.....Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape

C. Federal Specifications (Fed. Spec.):
A-A-59544-00 ..... Cable and Wire, Electrical (Power, Fixed Installation)

D. National Fire Protection Association (NFPA):
70-05..... National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):
44-02..... Thermoset-Insulated Wires and Cables
83-03..... Thermoplastic-Insulated Wires and Cables
467-01 ..... Electrical Grounding and Bonding Equipment
486A-01 ..... Wire Connectors and Soldering Lugs for Use with Copper Conductors
486C-02 ..... Splicing Wire Connectors
486D-02 ..... Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
486E-00 ..... Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493-01 ..... Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
514B-02 ..... Fittings for Cable and Conduit
1479-03 ..... Fire Tests of Through-Penetration Fire Stops

F. NFPA 70: National Electric Code

G. NFPA 101: Life Safety Code.

H. Occupational Safety and Health Act (OSHA).

I. UL Listing of Communications Cabling and Hardware

J. Building Industry Consulting Services International; Telecommunications Distribution Methods Manual

K. ANSI/TIA/EIA-568-B - “Commercial Building Telecommunication Standard”.

L. ANSI/TIA/EIA-569-B - “Commercial Building Standard for Telecommunications Pathways and Spaces”.

M. ANSI/EIA/TIA-526-14 “Method B: Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant”.

N. ANSI/EIA/TIA-526-7 “Method 1: Optical Power Loss Measurements of Installed Single-mode Fiber Cable Plant”.

O. ANSI/TIA/EIA-606-A – “Administration Standard for the Telecommunications Infrastructure of Commercial Buildings”.

P. ANSI/J-STD-607 – “Commercial Building Grounding and Bonding Requirements for Telecommunications”.

Q. FCC – Part 67, for Communications Interconnection Devices

R. NEMA VE 1-1998 - Metallic Cable Tray Systems

S. NEMA VE 2-2000 - Cable Tray Installation Guidelines

T. Local Ordinances, Regulations of the Local Building Department and Fire Department

PART 2 - PRODUCTS

2.1 CONTROL WIRING

A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.

B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.2 COMMUNICATION AND SIGNAL WIRING

A. Shall conform to the recommendations of the manufacturers of the communication and signal systems; however, not less than what is shown.

B. Wiring shown is for typical systems. Provide wiring as required for the systems being furnished.

C. Multi-conductor cables shall have the conductors color coded.

2.3 WIRE LUBRICATING COMPOUND

A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

B. Shall not be used on wire for isolated type electrical power systems.

2.4 FIREPROOFING TAPE

A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.

B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.

C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.

D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.

E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install all wiring in raceway systems.

B. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.

C. Wire Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
2. Use ropes made of nonmetallic material for pulling feeders.
3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Resident Engineer.
4. Pull in multiple cables together in a single conduit.

3.2 INSTALLATION IN MANHOLES

A. Install and support cables in manholes on the steel racks with porcelain or equal insulators. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.

B. Communication and signal wiring shall not be in same manhole as electrical power conductors and cables.

3.3 CONTROL, COMMUNICATION AND SIGNAL WIRING INSTALLATION

A. Unless otherwise specified in other sections, install wiring and connect to equipment/devices to perform the required functions as shown and specified.

B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.

C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.

D. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.

E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

3.4 CONTROL, COMMUNICATION AND SIGNAL SYSTEM IDENTIFICATION

A. Install a permanent wire marker on each wire at each termination within 12” of terminations.

B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.

C. Wire markers shall retain their markings after cleaning.

D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.5 EXISITNG WIRING

A. Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

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SECTION 27 15 00
COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies the furnishing, installing, certification, testing, and guaranty of a complete and operating Voice and Digital Cable Distribution System (here-in-after referred to as "*the System*"), and associated equipment and hardware to be installed in the VA SLVHCS Replacement Medical Center here-in-after referred to as "the Facility". The System shall include, but not be limited to: equipment cabinets, interface enclosures, and relay racks with, voice and data patch panels and associated hardware. The System shall additionally include, but not be limited to: Telecommunications Equipment Rooms (TER) telecommunications outlets (TCO); Unshielded Twisted Pair (UTP) copper distribution cables, connectors, and "patch" cables.

B. The Horizontal Distribution System shall be delivered free of engineering, manufacturing, installation, and functional defects. It shall be designed, engineered installed and Permanent Link tested for certification in accordance with ANSI/TIA/EIA-568-C.2 standards.

C. The term "Horizontal Cabling" or "Horizontal Distribution" shall mean that part of the structured cabling system that extends from the work area telecommunications outlet faceplate and modular connector(s) to the horizontal cross connect patch panel at the equipment rack within the associated Telecommunications Equipment Room (TER). The Horizontal Distribution system includes the work area telecommunications outlet faceplate, modular connector(s), cross-connect patch panels and Unshielded Twisted Pair Cabling (UTP).

D. Bid Instructions:

1. Base bid shall be for Voice and Digital Cable Distribution System (*the System*).
2. Alternate bid shall be for IPLMS (Intelligent Physical Layer Management System) for copper and fiber optic station cabling and backbone cabling to substitute for passive copper and fiber optic station cabling and back bone system. See Section 27 15 00, 1.1 I. for details.

E. The term "provide", as used herein, shall be defined as: designed, engineered, furnished, installed, certified, and tested, by the Contractor.

F. The Voice and Digital Horizontal Distribution Cable Equipment and System provides the media which voice and data information travels over and connects to the IT Data Network and Telephone System which is defined as an Emergency Critical Care Communication System by the National Fire Protection Association (NFPA). Therefore, since the System connects to or extends the telephone system, the System's installation and operation shall adhere to all appropriate National, Government, and/or Local Life Safety and/or Support Codes, which ever are the more stringent for this Facility.

At a minimum , the System shall be installed according to NFPA, Section 70, National Electrical Code (NEC), Article 517 and Chapter 7; NFPA, Section 99, Health Care Facilities, Chapter 3-4; NFPA, Section 101, Life Safety Code, Chapters 7, 12, and/or 13; Joint Commission on Accreditation of Health Care Organization (JCAHCO), Manual for Health Care Facilities, all necessary Life Safety and/or Support guidelines; this specification; and the original equipment manufacturer's (OEM) suggested installation design, recommendations, and instructions. The OEM and Contractor shall ensure that all management, sales, engineering, and installation personnel have read and understand the requirements of this specification before the System is designed, engineered, delivered, and provided.

G. The VA Project Manager (PM) and/or if delegated, Resident Engineer (RE) are the approving authorities for all contractual and mechanical changes to the System. The Contractor is cautioned to obtain in writing, all approvals for system changes relating to the published contract specifications and drawings, from the PM and/or the RE before proceeding with the change.

H. System Performance:

1. At a minimum, the System shall be able to support the following voice and data operations for Augmented Category 6 (Category 6A) Certified Telecommunication Service: in accordance with ANSI/TIA/EIA-568C and the following applications:

a. Provide the following interchange (or interface) capabilities:

1) Basic Rate (BRI).
2) Primary Rate (PRI).

b. ISDN measured

1) Narrow Band BRI:

a) B Channel: 64 kilo-Bits per second (kBps), minimum.
b) D Channel: 16 kBps, minimum.
c) H Channel: 384 kBps, minimum.

2) Narrow Band PRI:

a) B Channel: 64 kBps, minimum.
b) D Channel: 64 kBps, minimum.
c) H Channel: 1,920 kBps, minimum.

3) Wide (or Broad) Band: All channels: 140 mega(m)-Bps, minimum, capable to 565 mBps at “T” reference.

c. ATM operation and interface: ATM 155 mBps
d. Frame Relay:
e. Integrated Data Communications Utility (IDCU) operation and interface: Government Open Systems Interconnection Profile (GOSSIP) compliant: Fiber optic Distributed Data Interface (FDDI): A minimum 100 mBps to a maximum of 1.8 giga(g)-Bps data bit stream speed shall be Synchronous Optical Network [SONET] compliant.

2. At a minimum the System shall support the following operating parameters:

a. EPBX connection:

1) System speed: 1.0 gBps per second, minimum.
2) Impedance: 600 Ohms.
3) Cross Modulation: -60 deci-Bel (dB).
4) Hum Modulation: -55 dB.
5) System data error: 10 to the -10 Bps, minimum.
6) Loss: Measured at the frame output with reference Zero (0) deciBel measured (dBm) at 1,000 Hertz (Hz) applied to the frame input.

a) Trunk to station: 1.5 dB, maximum.
b) Station to station: 3.0 dB, maximum.
c) Internal switch crosstalk: -60 dB when a signal of ± 10 deciBel measured (dBm), 500-2,500 Hz range is applied to the primary path.
d) Idle channel noise: 25 dBm “C” or 3.0 dBm “O” above reference (terminated) ground noise, whichever is greater.
e) Traffic Grade of Service for Voice and Data:

(1) A minimum grade of service of P-01 with an average traffic load of 7.0 CCS per station per hour and a traffic overload in the data circuits will not interfere with, or degrade, the voice service.
(2) Average CCS per voice station: The average CCS capacity per voice station shall be maintained at 7.0 CCS when the EPBX is expanded up to the projected maximum growth as stated herein.

b. Telecommunications Outlet (TCO):

1) Voice:

a) Isolation (outlet-outlet): 24 dB.
b) Impedance: 600 Ohms, balanced (BAL).
c) Signal Level: 0 deciBel per mili-Volt (dBmV) ± 0.1 dBmV.
d) System speed: 100 mBps, minimum.
e) System data error: 10 to the -6 Bps, minimum.

2) Data:

a) Isolation (outlet-outlet): 24 dB.
b) Impedance: 600 Ohms, BAL.
c) Signal Level: 0 dBmV ± 0.1 dBmV.
d) System speed: 120 mBps, minimum.
e) System data error: 10 to the -8 Bps, minimum.

I. Intelligent Physical Layer Management System – Alternate Bid

1. System Architecture

a. The hardware solution shall be made up of two basic components: intelligent patch panels and intelligent scanners.

b. The System shall have single or multiple tier distributed architecture; intelligent scanner is capable to communicate to multiple intelligent patch panels within the 100 meter distances with simple design rules that shall result in scalable system architecture.
c. The preferred method of connectivity detection shall be of proven technology, open/ close circuit as opposed to time sensitive sequential switching, in order to minimize the opportunity for error.
d. The IPLMS shall map all network devices with their location information regarding the exact location of each device in the network (building, floor, room number etc.)
e. The IPLMS shall facilitate virtual network-planning capabilities using intelligent patch panels in the structured cabling system and provide accurate, up-to-date documentation of the entire network's physical layer.
f. Supply, install, configure, test and commission the IPLMS Application Software and tools, for which the specified hardware and operating system software shall be provided by the Company.

    1) Supply, installation, testing, programming and commissioning of all hardware, software and database components of the IPLMS with required cabling includes:

        a) Intelligent Patch Panels
        b) System Scanner unit
        c) Faceplate with Cat6A outlets for data
        d) Faceplates with Cat6 outlets for voice

g. Running CAT6 Augmented cables up to 90 Meters from Intelligent Patch Panels to Workstation outlets, terminations and Patch Cords (2-mtr in the Patch Panel side and 3-mtr in the workstation outlet side).
h. Commissioning and testing of the entire system and handing over as a fully functional system integrated on to a single platform.
i. Provide as built Drawings, database updates of installed systems and System Documentation including manufacturer’s catalogs.
j. Provide on-site support personnel from the Second Year of the Contract for maintenance. Replacement of faulty units, provision of spares and consumables for maintenance shall be at no additional cost to the Company.
k. The proposed system solution shall be deployed without any modification or physical attachments to existing active equipment.
l. Training should be imparted to the Client’s personnel to ensure the continued proper utilization of the system.

2. System Capabilities

a. The IPLMS proposed by the contractor should provide advanced capabilities for management of the horizontal copper cabling system and should integrate with other similar sites of the client. The system should be manageable remotely from a central command and control centre.
b. The cable management system should be of a simple design and should use only the patch panels, scanner and application server. The design based on non-standard cables, optical sensors and other specialized proprietary equipment to establish the management is not considered as it is expected to increase operational complexity.

c. The Advanced Physical Layer Management System should provide the following features for horizontal copper connectivity:

1) The system shall provide connectivity verification across the entire data channel from the network attached device in the work area to the switch or similar network infrastructure device.
2) The system shall track channel connectivity even if connectivity to the system's monitoring and management system is lost and resynchronize automatically once communication is restored.
3) The system shall track connectivity within the system without continuous query of switch configuration tables.
4) Connectivity status changes on a channel shall initiate event-driven polling queries on that channel. System shall track connectivity without continuous polling of network-attached devices.
5) The system shall detect when devices connect or disconnect from the network. Detection shall happen even if the standard Ethernet device is not powered on at the time of connection or disconnection.
6) The system shall fail safe, allowing the continuous transportation of data over all data channels whether the system is powered on or not functioning properly.
7) The system shall only use standard RJ45 patch cords for connecting the scanner to the patch panel. These patch cords must be at a minimum Cat 6A compliant per ANSI/TIA/EIA 568-C and ISO/IEC 11801.
8) The system should be able to support a cross-connect architecture to avoid changes directly to switch ports.
9) The system's scanning device shall be capable of monitoring patch panels up to 100 meters away from the scanning device.
10) The system shall track connectivity changes and store the IP address and MAC address of network-attached devices.
11) The system shall be able to identify connection of network attached devices.
12) The system shall be able to detect loss or change of connectivity across all data cables, jacks and links monitored by the system, including but not limited to the following links: patch cord in the work area, horizontal cable from work area outlet to wire closet patch panel, cross connect patch cord between patch panels, and cable from presentation panel to active equipment. All copper cables used must be Cat6A compliant per ANSI/TIA/EIA 568-C and IEC/ISO 11801 standards.
13) The system must verify the continuity of the horizontal cable to the work area outlet and detect disconnections of network-attached devices or broken connections. The system shall determine whether a break is due to a bad patch in the Telecommunications Room, a break in the horizontal cable, or a disconnected patch between the work area outlet and the network-attached device.
14) The system shall track and report changes in connectivity status, including time of connection and disconnection for assets utilizing Ethernet protocol.
15) The system shall graphically display the location of work area outlets on building maps, including a symbol identifying the network-attached device present at the work area outlet and switch port. Current status and changes in status of each port of the channel shall be indicated by color coding at the port level.
16) The system shall provide graphical views of equipment racks and the status of each patch panel port in the system.
17) The system shall provide guided patching via visual indicators on patch panels for each port monitored by the system.
18) The system shall initiate a work order for a move, add, or change to the infrastructure and notify remote users of the system on the same WAN upon

completion of the work order. In the event of a break in communication between the application and scanner, completion of the work order shall be tracked and then notification shall occur once communication is restored.

19) Work orders shall be completed from the graphical user interface with pre-populated data fields.
20) The system shall allow the technician to complete simultaneous work orders in any sequence, including partial patches. Partial patches are defined as connection of multiple patches at one end followed by completion of multiple patches at the other end.
21) The system shall track completed work orders and adjust the work order queue to display guided patching for the next work order.
22) The system shall provide alerts based on connectivity changes in patches and endpoints in the physical channel.
23) Alerts levels shall be configurable to the port level.
24) The system shall support multiple remote users on the same WAN to access the system simultaneously.
25) The system shall support spreadsheet import of connectivity data.
26) The system shall provide for data backup.
27) The system shall provide licensing for unlimited users.
28) The system shall provide capability to search for assets recorded in the database.
29) The scanner shall have the capacity to monitor a minimum of 500 channels per 1U rack space.
30) The system shall not require fans.
31) The system's patch panel shall provide visual confirmation that the panel is powered and that the system is monitoring data channels.
32) The system shall power patch panel electronics from the scanner.
33) The system shall be able to communicate alerts to external management systems.
34) The system shall provide reports of alarms, devices, and connectivity status.
35) The system shall be able to discover devices beyond the device attached to the data channel.
36) The software shall be updated the moment a "circuit" is broken or disconnected. The software, upon receiving the connection information from the intelligent scanner, immediately updates the database.
37) System shall include support for SNMP v2.
38) System Software shall be web based to enable real-time visualization over the Company's networks.
39) The system shall provide audits, inventories and compares infrastructure documentation against existing enterprise asset management systems to ensure all site documentation is accurate and up to date.
40) The system shall determine if the connection/ disconnection was planned and authorized by comparing what actually happened to what was expected to happen.
41) The system shall provide full featured electronic work order capabilities that include paperless work order administration.
42) The system shall be capable to support cross-connect as well as interconnect topology.
43) The System support for interconnect topology shall be enabled without a need for special accessories to be installed on managed network equipment.

44) The System shall be able to generate real-time security alerts upon:

a) Insertion of a plug into intelligent panel port.
b) Removal of a plug from intelligent panel port.
c) Unauthorized MAC activity in a telecom room.
d) Cut in any patch cord.

3. Port Intelligent Patch Panel

a. Be made of powder-coated steel, in 24 port configurations.
b. Accommodate 24 ports for each rack mount space (1rms = 44 mm [1.75 in.]).
c. Allow for a minimum of 20 re-terminations without signal degradation below standards compliance limit.
d. Have port identification labeling card index strip in the front
e. Patch Panel design with a standard RJ45 data bus connection port in the rear of the panel.
f. Be able to detect connectivity at both the patch panel and the connected work area outlet.
g. Have built-in power status indicators
h. Include port LED's that indicate specific work orders or patch guidance.
i. Should have rear cable management tray supplied with cable ties.
j. All Category 6A panels shall meet or exceed Cat6A transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA -568-C.2 Commercial Building Telecommunications Cabling Standard.
k. Should be powered by the scanner and should not use any other power sources.

4. Intelligent Scanners – Hardware

a. System Controller is defined as a device that performs the following functions:

1) Communicate with intelligent patch panels
2) Provide power to intelligent patch panel on a rack
3) Record activity information
4) Communicate with the Intelligent Physical Layer Management System server via the network
5) Shall be compatible with mounting on 19" (width) based hardware plane and shall occupy not more than 1U of vertical rack space (height).
6) Shall have non-volatile memory to store connectivity information's that are collected from intelligent patch panels.
7) Shall have configurable Ethernet connections capability to connect to buildings/corporate LAN to enable communication with Management Software.
8) Enabling of Ethernet capabilities shall be provided via simple management programming network settings without use of external devices.
9) Shall be capable of being configured without being attached to the Server / System Software.

b. The IPLMS Solution shall use Scanners to discover connects/disconnects and communicate the information to the system software over a TCP-IP connection.
c. The Scanner should discover network-attached devices and should upload the same to the system application. The appliance should be capable of monitoring up to a minimum of 576 separate physical channels. The connection change state of the monitored channels should be captured and the state change data passed to the application software.
d. The Scanner should support the monitoring of the work area outlets and the respective patches in both cross-connect and interconnect environments. In cross

connect environments; switches shall be connected at the back of the IPLMS patch panel with half RJ45 patch cords ONLY.

e. The minimum requirement for the Scanner is as below:

Channels Monitored:	Up to 576 Channels
Universal AC input:	110-240VAC, 50-60Hz
Operating Conditions: 15 - 90% Relative Humidity	0 to 50^{O}C (32 to 122^{O} F),
Non-Condensing Storage Conditions: 10 - 95% Relative Humidity	10 to 60^{O} C (14 to 140^{O}F),
Non-Condensing Emissions:	FCC Pa 15 Class B, EN55055 Class B
Safety:	UL 1950, IEC 60950, CSA 950
Management:	HTTP, SNMP (read-only)
Max Power consumption:	15 Watts
Heat Generation:	51 BTU / Hour
Rack Space consumption:	1 Rack unit per 576 channels

5. IPLMS Software/License

   a. The Contractor shall procure and supply the System/Application Software registered on Company's name with the manufacturer.
   b. System/Application Software shall be of the latest version.
   c. System/Application Software and tools shall be supplied by the Contractor with unlimited number of nodes/ports licensing for the initial listed sites as per contract and shall be transferred to the ownership of the Company upon expiry of the contract.
   d. Unlimited number of user access license for the listed sites and number of ports installed for.
   e. System/Application License, support contacts and contracts/agreement from the manufacturer shall be transferred to the ownership of the Company upon expiry of the contract.
   f. Software shall be ready for use right out of a shipping box.
   g. Throughout the Contract Period of first 3 years the System/Application software shall be upgraded with the latest version without any additional cost to the company.

6. Solderless Connectors: The connectors (or fork connectors) shall be crimp-on insulated lug to fit a 6-32 minimum screw terminal. The fork connector shall be installed using a standard lug-crimping tool.
7. Punch Blocks: As a minimum, Industry Standard 110 type punch blocks are approved for data, voice, and control wiring. Punch blocks shall be specifically designed for the size and type of wire used. Punch block strips shall be secured to a console, cabinet, rail, panel, etc. Punch blocks shall not be used for Class II or 120 VAC power wiring.
8. Wire Wrap Strips: Industry Standard wire wrap strips (16.5 mm (0.065in.) wire wrap minimum) are approved for data, voice and control wiring. Wire wrap strips shall be secured to a cabinet, rail, panel, etc. Wire wrap strips shall not be used for Class II or 120 VAC power wiring.

J. Wire Management System and Equipment:

1. Wire Management System: The system(s) shall be provided as the management center of the respective cable system, CCS, and TER it is incorporated. It shall perform as a platform to house peripheral equipment in a standard relay rack or equipment cabinet. It shall be arranged in a manner as to provide convenient access to all installed management and other equipment. All cables and connections shall be at the rear of each system interface to IDC and/or patch panels, punch blocks, wire wrap strips, and/or barrier strip.
2. Wire Management Equipment: The wire management equipment shall be the focal point of each wire management system. It shall provide an orderly interface between outside and inside wires and cables (where used), distribution and interface wires and cables, interconnection wires and cables and associated equipment, jumper cables, and provide a uniform connection media for all system fire retardant wires and cables and other subsystems. It shall be fully compatible and interface to each cable tray, duct, wireway, or conduit used in the system. All interconnection or distribution wires and cables shall enter the system at the top (or from a wireway in the floor) via a overhead protection system and be uniformly routed down either side (or both at the same time) of the frames side protection system then laterally via a anchoring or routing shelf for termination on the rear of each respective terminating assembly. Each system shall be custom configured to meet the System design and user needs.

K. Server

1. The management system shall be Microsoft Windows based and shall be installed on a dedicated server in the Main Computer Room. The software shall be compatible to run on the VA's server standard as follows.

   a. Software Prerequisites:

      1) MS- Windows (Server 2008 R2) – LATEST UPDATES & PATCHES APPLIED
      2) MS-IIS
      3) MS-SQL Express (Free Download –2008 R2 Express)
      4) MS .NET 3.5
      5) Crystal Reports

   b. Hardware Prerequisites:

      1) 4GB RAM
      2) AMD AthlonX2 or Intel Core Duo; 2GHz.
      3) 200GB HD

2. Database Configuration

   a. The Contractor shall be responsible for the provision of data/records that will be used for integration to the management system database. These responsibilities shall include, but not be limited to, the creation of all database connections; the completion of any record customization and the associated creation rules, categories and object data; the configuration of events; the construction of common searches and reports.

b. The system database produces user-defined reports on a regular basis. These reports include, but are not limited to:

1) Used and un-used port and equipment capacity definable by floor, area, room, cabinet and frame.
2) Statistics of MAC conducted between user definable dates.

c. The system database is configured to conduct user-defined queries enabling the Company to:

1) Locate and trace specific devices or device types on the network within the database and on the floor-plans.
2) Conduct audits

d. During installation, simultaneous patching, within each patch zone, must be supported in order to reduce project installation time. The Company requires that the database shall have a graphics capability where they will be able to;

1) View a physical representation of the connectivity chain.
2) View floor plans in jpeg/png formats identifying the locations of connected equipment.
3) View a graphical representation of wiring closets and associated cabinets and frame layouts.

e. Information to be viewed via the graphics module(s) shall include but not be limited to:

1) JPEG/PNG format floor-plans.
2) CAD drawings shall be converted by a 3rd party software into Jpeg/Png formats before loading into the systems.
3) Desking.
4) Outlet locations.
5) Equipment locations (identified by icon).
6) Device database entry information.
7) Equipment room, frame and cabinet layouts.
8) Patch panel orientation and connectivity.

f. The Contractor shall configure and populate the database with active equipment (switch) parameters to provide full visibility of any user end-to-end.

1.2 RELATED WORK

A. Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Specification Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

C. Specification Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.

D. Specification Section 27 10 00, STRUCTURED CABLING.

E. Specification Section 26 27 26, WIRING DEVICES.

F. Specification Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

G. Specification Section 26 41 00, FACILITY LIGHTNING PROTECTION.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. Except for a specific date given the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date the system's submittal is technically approved by VA, shall be enforced.

B. National Fire Protection Association (NFPA):

70	NATIONAL ELECTRICAL CODE (NEC)
75	Protection of Electronic Computer/Data Processing Equipment
77	Recommended Practice on Static Electricity
	Standard for Health Care Facilities
101	Life Safety Code
1221	Emergency Services Communication Systems

C. Underwriters Laboratories, Inc. (UL):

65	Wired Cabinets
96	Lightning Protection Components
96A	INSTALLATION REQUIREMENTS FOR LIGHTNING PROTECTION SYSTEMS
467	Grounding and Bonding Equipment
497/497A/497B	PROTECTORS FOR PAIRED CONDUCTORS/ COMMUNICATIONS CIRCUITS/DATA COMMUNICATIONS AND FIRE ALARM CIRCUITS
884	Underfloor Raceways and Fittings

D. ANSI/EIA/TIA Publications:

568C	Commercial Building Telecommunications Wiring Standard**s** including 568-C.0, 568-C.1, 568-C.2
569B	Commercial Building Standard for Telecommunications Pathways and Spaces
606A	ADMINISTRATION STANDARD FOR THE TELECOMMUNICATIONS INFRASTRUCTURE OF COMMERCIAL BUILDINGS
607A	Grounding and Bonding Requirements for Telecommunications in Commercial Buildings
758	Grounding and Bonding Requirements for Telecommunications in Commercial Buildings

E. International Telecommunication Union – Telecommunication Standardization Sector (ITU-T).

F. Federal Information Processing Standards (FIPS) Publications.

G. Federal Communications Commission (FCC) Publications: Standards for telephone equipment and systems.

H. United States Air Force: Technical Order 33K-l-lOO Test Measurement and Diagnostic Equipment (TMDE) Interval Reference Guide.

I. Joint Commission on Accreditation of Health Care Organization (JCAHO): Comprehensive Accreditation Manual for Hospitals.

J. National and/or Government Life Safety Code(s): The more stringent of each listed code.

1.4 QUALITY ASSURANCE

A. The authorized representative of the OEM, shall be responsible for the design, satisfactory total operation of the System, and its certification.

B. The OEM shall meet the minimum requirements identified in Paragraph 2.1.A. Additionally, the Contractor shall have had experience with three or more installations of systems of comparable size and complexity with regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Identification of these installations shall be provided as a part of the submittal as identified in Paragraph 1.5.

C. The System Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of three (3) years. The System Contractor shall be authorized by the OEM to certify and warranty the installed equipment. In addition, the OEM and System Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the System. This documentation, along with the System Contractor and OEM certification must be provided in writing as part of the Contractor's Technical Submittal.

D. All equipment, cabling, terminating hardware, TCOs, and patch cords shall be sourced from the certifying OEM or at the OEM's direction, and support the System design, the OEM's quality control and validity of the OEM's warranty.

E. The Contractor's Telecommunications Technicians assigned to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, and testing of the System. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the RE before being allowed to commence work on the System.

1.5 SUBMITTALS

A. Provide six (6) sets of submittals in accordance with Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. The Architect and RE shall retain one copy for review and approval.

1. If the submittal is approved the RE shall retain one copy for Official Records and return three (3) copies to the Contractor.
2. If the submittal is disapproved, three (3) copies will be returned to the Contractor with a written explanation attached that indicates the areas the submittal deviated from the System specifications. The RE shall retain one copy for Official Records.

B. Documents: The submittal shall be separated into sections for each subsystem and shall contain the following:

1. Title page to include:

   a. VA Replacement Medical Center.
   b. Contractor's name, address, and telephone (including FAX) numbers.
   c. Date of Submittal.
   d. VA Project No.

2. List containing a minimum of three locations of installations of similar size and complexity as identified herein. These locations shall contain the following:

   a. Installation Location and Name.
   b. Owner's or User's name, address, and telephone (including FAX) numbers.
   c. Date of Project Start and Date of Final Acceptance by Owner.
   d. System Project Number.
   e. Brief (three paragraphs minimum) description of each system's function, operation, and installation.

3. Narrative Description of the system.
4. A List of the equipment to be furnished. The quantity, make, and model number of each item is required including but not limited to the following:.

QUANTITY	UNIT
As required	Cabinet Assembly(s)
As required	Distribution/Interface Cabinet
As required	19-inch x 84-inch Equipment Rack
As required	Cross Connection (CCS) Systems
As required	Wire Management System/Equipment
As required	Telecommunications Outlets (TCO)
As required	Distribution Cables
As required	TCO Connection Cables
As required	System Connectors
As required	Distribution Frames

5. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
6. Engineering drawings of the System, showing calculated signal levels at the EPBX output, each input and output distribution point, proposed TCO values, and signal level at each TCO jack.
7. List of test equipment as per paragraph 1.5.D. below.
8. Letter certifying that the Contractor understands the requirements of the SAMPLES Paragraph 1.5.E.
9. Letter certifying that the Contractor understands the requirements of Section 3.2 concerning acceptance tests.

C. Test Equipment List:

1. The Contractor is responsible for furnishing all test equipment required to test the system in accordance with the parameters specified. Unless otherwise stated, the test equipment shall not be considered part of the system. The Contractor shall furnish test equipment of accuracy better than the parameters to be tested.

2. The test equipment furnished by the Contractor shall have a calibration tag of an acceptable calibration service recorded with the National Institute of Standards and Technology, dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:

    a. Spectrum Analyzer.
    b. Signal Level Meter.
    c. Volt-Ohm Meter.
    d. Time Domain Reflectometer (TDR) with strip chart recorder (Data and Optical Measuring).
    e. Bit Error Test Set (BERT).

3. The test equipment (the tester) shall comply with the accuracy requirements for level III field testers as defined in ANSI/TIA-1152. The tester including the appropriate interface adapter shall meet the specified accuracy requirements.

D. Samples: A sample of each of the following items shall be furnished to the RE for approval prior to installation.

1. TCO Wall Outlet Box 6" x 6"x 2.5" with:

    a. Two each telephone (or voice) rj45 jack installed.
    b. Two each multi pin data rj45 jacks installed.
    c. Cover Plate installed.

2. Data CCS patch panel with RJ45 connectors installed.
3. Telephone CCS system with IDC and/or RJ45 connectors and cable terminal equipment installed.
4. 610 mm (2 ft.) section of each copper cable to be used with cable sweep tags as specified in paragraph 2.4.H and connectors installed.

E. Certifications:

1. Submit written certification from the OEM indicating that the proposed supervisor of the installation and the proposed provider of the contract maintenance are authorized representatives of the OEM. Include the individual's exact name and address and OEM credentials in the certification.
2. Submit written certification from the OEM that the wiring and connection diagrams meet National and/or Government Life Safety Guidelines, NFPA, NEC, UL, this specification, and JCAHCO requirements and instructions, requirements, recommendations, and guidance set forth by the OEM for the proper performance of the System as described herein. The VA will not approve any submittal without this certification.
3. Preacceptance Certification: This certification shall be made in accordance with the test procedure outlined in paragraph 3.2.B.

F. Equipment Manuals: Fifteen (15) working days prior to the scheduled acceptance test, the Contractor shall deliver four complete sets of commercial operation and maintenance manuals for each item of equipment furnished as part of the System to the RE. The manuals shall detail the theory of operation and shall include narrative descriptions, pictorial illustrations, block and schematic diagrams, and parts list.

G. Record Wiring Diagrams:

1. Fifteen (15) working days prior to the acceptance test, the Contractor shall deliver four complete sets of the Record Wiring Diagrams of the System to the RE. The diagrams shall show all inputs and outputs of electronic and passive equipment correctly identified according to the markers installed on the interconnecting cables, Equipment and room/area locations.
2. The Record Wiring Diagrams shall be in hard copy and two compact disk (CD) copies properly formatted to match the Facility's current operating version of Computer Aided Drafting (REVIT) system. The RE shall verify and inform the Contractor of the version of AutoCAD being used by the Facility.

H. Surveys Required As A Part Of The Technical Submittal: The Contractor shall provide the following surveys that depict various system features and capacities are required in addition to the onsite survey requirements described herein. Each survey shall be in writing and contain the following information (the formats are suggestions and may be used for the initial Technical Submittal survey requirements), as a minimum:

1. The required EPBX connections (each CSU shall be compatible with) shall be compatible with the following:

a. Initially connect:

EQUIPPED ITEM	CAPACITY	WIREDCAPACITY
Main Station Lines		
Single Line		
Multi Line (Equipped for direct input dial [DID])		
Central Office (CO) Trunks		
TWO WAY		
DID		
Two-way DRTL		
Foreign Exchange (FX)		
Conference		
Radio Paging Access		
Audio Paging Access		
Off-Premise Extensions		
CO Trunk By-pass		
CRT w/keyboard		
Printers		
Attendant Consoles		
T-1 Access/Equipment		
Maintenance console		

b. Projected Maximum Growth: The Contractor shall clearly and fully indicate this category for each item identified in Paragraph 1.4.H.1.a. as a part of the technical submittal. For this purpose, the following definitions and sample connections are provided to detail the system's capability:

EQUIPPED ITEM	CAPACITY	WIRED CAPACITY
Servers		
PC's		
Projected Maximum Growth		

c. The Contractor shall clearly and fully indicate this category for each item identified in Paragraph 1.4.H.2.a. as a part of the technical submittal.

2. Cable Distribution System Design Plan: A design plan for the entire cable distribution systems requirements shall be provided with this document. A specific cable count shall coincide with the total growth items as described herein. It is the Contractor's responsibility to provide the Systems entire cable requirements and engineer a distribution system requirement plan using the format of the following paragraph(s), at a minimum:

a. UTP (and/or STP) Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identifies the building by number, title, or location, and main signal closet or intermediate signal closet cabling is provided from
BUILDING	Identifies the building by number, title, or location cabling is to be provided in
TO BUILDING IMC	Identifies building main terminal signal closet, by room number or location, to which cabling is provided too, in, and from
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.) cabling and TCOs are to be provided
TC ROOM NUMBER	Identifies the floor signal closet room, by room number, which cabling shall be provided
ROOM NUMBER	Identifies the room, by number, from which cabling and TCOs shall be provided
NUMBER OF CABLE PAIR	Identifies the number of cable pair required to be provided on each floor designated OR the number of cable pair (VA Owned) to be retained
NUMBER OF STRANDS USED/SPARE	Identifies the number of strands provided in each run

b. Fiber Optic Cabling Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identifies the building by number, title, or location, and main signal closet or intermediate signal closet cabling is provided from
TO BUILDING IMC	Identifies building, by number, title, or location, to which cabling is provided
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.)
TC ROOM NUMBER	Identifies the room, by number, from which cabling shall be installed
NUMBER OF STRANDS	Identifies the number of strands in each run of fiber optic cable
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein
NOTES	Identifies a note number for a special feature or equipment
BUILDING MTC	Identifies the building by number or title

3. Telecommunication Outlets: The Contractor shall clearly and fully indicate this category for each outlet location and compare the total count to the locations identified above as a part of the technical submittal. Additionally, the Contractor shall indicate the total number of spares.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. System Requirements:

1. The System shall provide the following minimum services that are designed in accordance with and supported by an Original Equipment Manufacturer (OEM), and as specified herein. The System shall provide continuous inter and/or intra-Facility voice and data, service. The System shall be capacity sized so that loss of connectivity to external telephone systems shall not affect the Facilities operation in specific designated locations. The System shall:

   a. Be capable of inter-connecting and functioning fully with the existing Local Telephone Exchange (LEC) Network(s), Federal Telephone System (FTS) Inter-city Network(s), Inter-exchange Carriers, Integrated Services Digital Network (ISDN), Electronic Private Branch Exchange (EPBX) switches, asynchronous/synchronous data terminals and circuits including Automatic Transfer Mode (ATM), Frame Relay, and local area networks (LAN), at a minimum.
   b. Be a voice and data cable distribution system that is based on a physical “Star” Topology. The distribution system shall be provided in a “home run” configuration from each associated TER room to identified locations and work area telecommunications outlet configurations as shown on the drawings.
   c. Be compatible with and able to provide direct digital connection to trunk level equipment including, but, not limited to: directly accessing trunk level equipment including the telephone system, audio paging, Industry Standard “T” and/or “DS” carrier services and external protocol converters. Additionally, connections to “T” and/or “DS” access/equipment or Customer Service Units (CSU) that are used in FTS and other trunk applications shall be included in the System design.

2. Cable Systems - Twisted Pair, Fiber Optic, Analog RF Coaxial

a. General:

1) The Contractor shall be responsible for providing a new system conforming to current and accepted telephone and digital cable distribution standards. The distribution cable installation shall be fully coordinated with the Facility, the PM, the RE and the Contractor prior to the start of installation.
2) The Contractor is responsible for complete knowledge of the space and cable pathways (i.e. equipment rooms, TCs, conduits, wireways, etc.) of the Facility. The Contractor shall at a minimum design and install the System using the OI & T Design Guide PG-18-12 and EDM PG-18-10, TIA/EIA Telecommunications Building Wiring Standards, and Facility Chief of Information Resource Management's (IRM) instructions, as approved in writing by the PM and/or RE.
3) The System cables shall be fully protected by cable duct, trays, wireways, conduit (rigid, thin wall, or flex), and when specifically approved, flexible inner duct. It is the responsibility of the Contractor to confirm all contract drawings and the Facility's physical layout to determine the necessary cable protective devices to be provided. If flexible inner duct is used, it shall be installed in the same manner as conduit.
4) Cable provided in the system (i.e. backbone, outside plant, inside plant, and station cabling) shall conform to accepted industry and OEM standards with regards to size, color code, and insulation. The pair twists of any pair shall not be exactly the same as any other pair within any unit or sub-unit of cables that are bundled in twenty-five (25) pairs or less. The absence of specifications regarding details shall imply that best general industry practices shall prevail and that first quality material and workmanship shall be provided. Certification Standards, (i.e., EIA, CCITT, FIPPS, and NFPA) shall prevail.
5) Some areas of this Facility may be considered "plenum". All wire and cable used in support of the installation in those areas (if any) shall be in compliance with national and local codes pertaining to plenum environments. It is the responsibility of the Contractor to review the VA's cable and wire requirements with the RE and the IRM prior to installation to confirm the type of environment present at each location.
6) The Contractor shall provide outside and inside plant cables that furnishes the number of cable pairs required in accordance with the System requirements described herein. The Contractor shall fully coordinate and obtain approval of the design with the OEM, RE and the IRM prior to installation.
7) All metallic cable sheaths, etc. shall be grounded by the Contractor (i.e.: risers, underground, station wiring, etc.) as described herein.
8) If temporary cable and wire pairs are used, they shall be installed so as to not present a pedestrian safety hazard and the Contractor shall be responsible for all work associated with the temporary installation and for their removal when no longer necessary. Temporary cable installations are not required to meet Industry Standards; but, must be reviewed and approved by the RE and the IRM prior to installation.
9) Conductors shall be cabled to provide protection against induction in voice and data circuits. Crosstalk attenuation within the System shall be in excess of -80 dB throughout the frequency ranges specified.

10) The System's cables shall be labeled on each end and been fully tested and certified in writing by the Contractor to the RE before proof of performance testing can be conducted. Minimum test requirements are as follows:

    a) Wire Map
    b) Length
    c) Insertion Loss
    d) NEXT Loss
    e) PS NEXT Loss
    f) ACR-F Loss
    g) PS ACR-F Loss
    h) Return Loss
    i) Propagation Delay
    j) Delay Skew

11) The Contractor shall coordinate with the RE and the IRM to install the computer interface cable to the Facility Telephone Switch Room from the Facility's Computer Room for all data, DHCP, FTS, ATM, Frame Relay, and telephone circuits and as shown on the drawings.
12) The Contractor shall coordinate with the RE and the IRM to provide all cable pairs/circuits from the Facility Telephone Switch Room and establish circuits throughout the Facility for all voice, data, and any low voltage circuits as described herein.
13) The Contractor shall provide proper test equipment to guarantee that cable pairs meet each OEM's standard transmission requirements, and guarantee the cable will carry data transmissions at the required speeds, frequencies, and fully loaded bandwidth.

b. Telecommunications Closets (TC): In TC's that are served with both a UTP backbone cable and a fiber optic backbone cable, the UTP cable shall be terminated on separate RJ-45, 8-pin connectors with 110A or equivalent type punch down blocks located on the back or front of a 48-port modular patch panel dedicated to data applications. Only the UTP backbone cable pairs, identified as being connected to the fiber optic backbone, shall be extended to the fiber optic interface device. All connecting cables required to extend these cables (i.e. patch cords, twenty-five pair connectors, etc.), to the fiber optic interface device, in the TC's shall also be provided by the Contractor to insure a complete and operational fiber optic distribution system.
c. Backbone and Trunk Cables:

1) The Contractor shall identify, in the technical submittal, the voice and data (analog RF coaxial cable shall not be provided in main trunk or backbone lines) connecting arrangements required by the LEC for interconnection of the System to the commercial telephone and FTS networks. The Contractor shall provide all required voice and data connecting arrangements.
2) The Contractor shall be responsible for compatibility of the proposed TCs (to be compliant with the EPBX and CSU equipment) numbering scheme with the numbering plan for the FTS, DID, local stations, and the North American Numbering Plan. The Contractor shall consult with the VA and the LEC regarding the FTS and North American Numbering plan to be implemented for the Facility to ensure system compatibility.
3) All submitted equipment shall meet or exceed standards, rules, and regulations of the Federal Communications Commission (FCC) and shall be capable of operating without outboard or "extra" devices. The Contractor shall identify the FCC registration number of the System equipment, EPBX, and proposed CSU (if known) in the technical submittal.

4) A minimum of one (1) 400 shielded twisted pair (STP) cable shall be installed from the Telephone Switch Room cross connecting system (CCS) to the Main Computer Room MDF. This cable shall support the transmission of data information over twisted pair cable. The cable shall be tested and terminated on a Contractor provided cable management frame, RJ-45 modular jacks with eight (8) pin connectors, and 48 port modular patch panels located in the Main Computer Room and Telephone Switch Room. The cable shall be labeled, terminated, and separated from the other cables on the MDF and Telephone Switch Room CCS. This requirement shall be fully coordinated and approved by the Facility Chief, IRM and the RE prior to installation. The cabling requirements of this paragraph are in addition to the requirements specified in the System Design Plan identified herein.

d. Riser Cable:

1) All communication riser cables shall be listed as being suitable for the purpose and marked accordingly per Articles 517, 700, and 800 of the NEC.
2) All voice and data communication (analog RF coaxial cable is not to be provided in riser systems) riser cables shall be STP or Unshielded Twisted Pair (UTP), minimum 24 American Wire Gauge (AWG) solid, thermoplastic insulated conductors. They shall be enclosed with a thermoplastic outer jacket.
3) The Contractor shall provide and install inside riser cables to insure full service to all voice cable pairs identified in each TC terminating enclosure plus not less than 50% additional spare capacity.
4) The complete riser cabling system shall be labeled and tested as described herein.

e. Horizontal and Station Cable:

1) A Four-pair (4) UTP 23 AWG station wiring cable shall be installed from each of the top two TCO jacks to the TC and shall be of a type designed to support Category 6 communications. At the jack location, terminate all four pair on an 8P8C modular RJ-45 jacks. At the TR, all four pair shall be terminated on the 110 punchdown block located on the wall field and designated for voice service.
2) A Four-pair (4) UTP 23 AWG Augmented Category 6 (Category 6A) distribution cable shall be installed from each of the two (2) bottom TCO RJ-45 jacks and shall conform to EIA/TIA-568-C Standards and the "T568A"-wiring scheme. At the TR, all four pair shall be terminated on the modular patch panel located on the equipment rack and designated for IT/Network services.

f. Telecommunication Outlets (TCO), Jacks: All TCO’s shall have RJ45 jacks per drawings.

g. Patient Bedside Prefabricated Units (PBPU): Where PBPU’s exist in the Facility, the Contractor shall identify the single gang "box" location on the PBPU designated for installation of the telephone jack. This location shall here-in-after be identified as the PBTCO. The Contractor shall be responsible for obtaining written approval and specific instructions from the PBPU OEM regarding the necessary disassembly and reassembly of each PBPU to the extent necessary to pull wire from above the ceiling junction box to the PBPU box reserved for the PBTCO. A Contractor provided stainless steel cover plate approved for use by the PBPU OEM and Facility IRM Chief shall finish out the jack installation.

Under no circumstances shall the Contractor proceed with the PBPU installations without the written approval of the PBPU OEM and the specific instructions regarding the attachment to or modifying of the PBPU. The RE shall be available to assist the Contractor in obtaining these approvals and instructions in a timely manner as related to the project's time constraints. It is the responsibility of the Contractor to maintain the UL integrity of each PBPU. If the Contractor violates that integrity, it shall be the responsibility of the Contractor to obtain on site UL re-certification of the violated PBPU at the direction of the RE and at the Contractor's expense.

h. Fiber Optics:

1) A complete fiber optic cable distribution system shall be provided as a part of the System. The Contractor shall provide a fiber optic cable that meets the minimum bandwidth requirements for FDDI, ATM, and Frame Relay services. This fiber optic cable shall be a 50/125 0M4 micron multi-mode, containing a minimum of 18 strands of fiber, unless otherwise specified, and shall not exceed a distance of 2,000 Meters (M), or 6,560 feet (ft.) in a single run. Loose tube cable, which separates the individual fibers from the environment, shall be installed for all outdoor runs or for any area which includes an outdoor run. Tight buffered fiber cable shall be used for indoor runs. The multimode fibers shall be terminated and secured at both ends in "ST" type female stainless steel connectors installed in an appropriate patch or breakout panel with a cable management system. A 610 mm (2 ft.) cable loop (minimum) shall be provided at each end to allow for future movement.

2) In addition, a 12 strand (minimum), 8.3 mm single mode fiber optic cable shall be provided. Single mode fibers shall be terminated and secured at both ends with "ST" type female stainless steel connectors installed in an appropriate patch or breakout panel. The panel shall be provided with a cable management system. A 610 mm (2 ft.) cable loop (minimum) shall be provided at each end to allow for future movement.

3) The fiber optic backbone shall use a conventional hierarchical "star" design where each TC is wired to the primary hub (main cross-connect system) or a secondary hub (intermediate cross-connect system) and then to the primary hub. There shall be no more than two hierarchical levels of cross-connects in the backbone wiring. Each primary hub shall be connected and terminated to a CCS in the Telephone Switch Room. Additionally, a parallel separate fiber optic interconnection shall be provided between the Telephone Switch Room CCS and the MDF in the Main Computer Room.

4) In the TC's, Telephone Switch Room, and Main Computer Room, all fiber optic cables shall be installed in a CCS and/or MDF rack mounted fiber optic cable distribution component/splice case (Contractor provided and installed rack), patch, or breakout panel in accordance with industry standards. Female "ST" connectors shall be provided and installed on the appropriate panel for termination of each strand.

5) The Contractor shall test each fiber optic strand. Cable transmission performance specifications shall be in accordance with EIA/TIA standards. Attenuation shall be measured in accordance with EIA fiber optic test procedures EIA/TIA-455-46, -61, or -53 and NFPA. Information transmission capacity shall be measured in accordance with EIA/TIA-455-51 or -30 and NFPA. The written results shall be provided to the RE for review and approval.

3. Specific Subsystem Requirements: The System shall consist, as a minimum, of the following independent sub-systems to comprise a complete and functional voice and digital telecommunications cabling system: for "horizontal" cabling system**s**, horizontal cross-connection, and TCO's with a minimum of four (4) RJ-45 jacks for the appropriate telephone, Data connections, and additional jacks, connectors, drop and patch cords, terminators, and adapters provided.

    a. Cross-connect Systems (CCS):

        1) The CCS shall be selected based on the following criteria: requires the use of a single tool, has the fewest amount of parts, and requires the least amount of assembly or projected trouble shooting time during the life of the system.
        2) The CCS system used at the MCR, and each TC shall force cross-connect cable slack management through adherence to the OEM's installation methods, provided cable management systems, and as described herein, so that moves, adds, and changes can be administered easily and cost effectively.
        3) Copper Cables: The MCR and TC shall contain a copper CCS sized to support the System TCO's and connections served by each individual TC and as shown on the drawings. The System layout shall allow for a minimum of 50% anticipated growth. Additionally, each CCS must provide maximum flexibility, while maintaining performance, in order to meet system-changing requirements that are likely to occur throughout its useful life.
        4) Fiber Optic Cables:

            a) The MTC and each TC shall contain a fiber CCS sized to support the System TCO's and connections served by each individual TC and as shown on the drawings. The System layout shall allow for a minimum of 50% anticipated growth.
            b) Each fiber CCS must provide maximum flexibility and cable management while maintaining performance in order to meet changing requirements that is likely to occur throughout the expected life of the system. All fiber optic cable slack shall be stored in protective enclosures.
            c) If it is determined that a fiber optic distribution system is not necessary for the immediate system needs. Each TC shall be provided with fiber optic cable(s) that contain a minimum of 12 strands "dark" multimode fiber and 12 strands "dark" single mode fiber, each fiber properly terminated on its respective female stainless steel connector mounted in an appropriate fiber termination enclosure provided in each TC.

        5) The Contractor shall not "cross-connect" the copper or fiber optic cabling systems and subsystems even though appropriate "patch" cords are to be provided for each "patch", "punch", or "breakout" panel. In addition, the Contractor shall not provide active electronic distribution or interface equipment as a part of the System.

6) Grounding: Proper grounding and bonding shall be provided for each TC and all internal equipment. Reference shall be made to proper codes and standards, such that all grounding systems must comply with all applicable National, Regional, and Local Building and Electrical codes. The most stringent code of these governing bodies shall apply.

   a) If local grounding codes do not exist for the System location, then at a minimum, a #6 American Wire Gauge (AWG) stranded copper wire, or equivalent copper braid, shall be connected to a separate earth grounding system for each TC (the looping of TC's in a general location is allowed as long as the specifications contained herein are met). Under no circumstance shall the AC neutral be used for this ground. See PART 3 – EXECUTION for specific grounding instructions.
   b) Each copper UTP cable that enters a TC from the outside of a building (regardless if the cable is installed underground or aerial) shall be provided with a surge protector and grounded an to earth ground at each cable's entry point in and out of the MCR.

7) The CCS system shall have the flexibility to cross connect a four pair CAT 6A cable from 110A block to RJ45 patch panel. Contractor shall provide patch cords to enable VOIP activation from 100% of the voice station outlets on 110A to connect to RJ45 patch panel.

b. Main Cross-connection Subsystem (MCCS): The MCCS shall be located in the MCR.

c. Voice (or Telephone) Cable Cross-Connection Subsystem:

1) Due to the usually high number of copper cable termination's required at the MCCS, Insulation Displacement Connection (IDC) hardware shall be used. Termination options shall include the following for a Augmented Category 6 (Category 6A) Cabling System: IDC termination of cross-connection wire(s), IDC patch cord connector to IDC patch cord connector, and hybrid modular cord to IDC patch cord connector shall be the minimum provided.
2) Additionally, due to the large or many MCCS (at initial installation and over the life of the System) copper termination points, the CCS that makes the best use of real estate while still following the OEM design and installation guidelines, and meeting the specifications described herein, shall be provided.
3) For ease of maintenance purposes, all terminations shall be accessible without the need for disassembly of the IDC wafer. IDC wafers shall be removable from their mounts to facilitate testing on either side of the connector. Designation strips or labels shall be removable to allow for inspection of the terminations. The maximum number of terminations on a wall or on a rack frame or panel shall comply with the OEM recommendations and guidelines, and as described herein. A cable management system shall be provided as a part of the IDC.
4) IDC connectors shall be capable of supporting cable re-terminations without damaging the connector and shall support a minimum of 200 (telephone equipment standard compliant) IDC insertions or withdrawals on either side of the connector panel.
5) A non-impact termination method using a full-cycle terminating tool having both a tactile and an audible feedback to indicate proper termination is required. For personnel safety and ease of use in day to day administration, high impact installation tools shall not be used.

6) The splitting of pairs within cables between different jacks or connections shall not be allowed. In the case of ISDN and/or ATM and /or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.
7) UTP cross connecting wires shall be provided for each modular jack or connection terminals plus an additional 50% spare.

d. Data Cross-Connection Subsystems:

1) The MCCS shall be a Main Distribution Terminating (MDT) data unit and shall be provided in the MTC. The MDT shall consist of a "patch" panel(s) provided with modular RJ45 female connectors for cross-connection of all copper data cable terminations. The panels shall provide for system grounding (where no dielectric cables are used) and be provided with a cable management system.
2) Each panel shall conform to EIA dimensions and be suitable for mounting in standard equipment racks, have the RJ45 jacks aligned in two horizontal rows (up to a maximum of 48 jacks per panel), and shall not exceed the OEM's recommendations. Each RJ45 jack shall be of modular design and capable of accepting and functioning with other modular (i.e. RJ11) plugs without damaging the jack. It is not necessary to provide a jack for unused positions that are not part of the 50% expansion requirement.

a) All data system inputs from the server(s), data LAN, bridge, or interface distribution systems shall appear on the "top" row of jacks of the appropriate patch panel.
b) All System outputs or backbone cable connections shall appear on the "bottom" row of jacks of the same patch panel.
c) The splitting of pairs within cables between different jacks shall not be allowed. In the case of ISDN and/or ATM and/or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.

3) A patch cord shall be provided for each system "pair" of connection jacks. Each patch cord shall have modular RJ45 connectors provided on each end to match the panel's modular RJ45 female jack's being provided.

e. Intermediate Cross-connection Subsystems (IMCCS): The MTC and each IMTC shall be provided with an IMCCS that shall be the connection point between the MCCS system and the distribution backbone cable and the IMCCS that is located in one or more buildings on a campus, where each IMCCS is placed by system design. For a technical explanation of internal equipment and system requirements, refer to the above MTC and MCCS paragraphs.
f. Fiber optic Cross-Connection Subsystems: The MTC shall be provided with a separate fiber MCCS. Each TC shall be provided with a rack mounted patch or distribution panel that is installed inside a lockable cabinet or "breakout enclosure" that accommodates a minimum of 12 strands multimode fiber and 12 strand single mode fiber (these counts shall not be included the 50% spare requirement). Two of the single mode fibers shall be designated for educational analog video applications. A cable management system shall be provided for each panel.

1) The panel(s) shall contain a minimum of 24 female "ST" connectors, be able to accommodate splices and field mountable connectors and have capacity for additional connectors to be added up to the OEM's maximum standard panel size for this type of use. All patch panel sides, including the front and back, shall be protected by a cabinet or enclosure.

2) The panel(s) shall conform to EIA dimensions and be suitable for installation in standard racks, cabinets, and enclosures. The panels shall provide for system grounding (where no dielectric cables are used).
3) The patch panel with the highest OEM approved density of fiber "ST" termination's (maximum of 72 each), while maintaining a high level of manageability shall be selected. Patch cables, with proper "ST" connectors installed on each end shall be provided for each pair of fiber optic cable "ST" connectors.

    a) All System "inputs" from interface equipment or distribution systems shall appear on the "top" row of connectors of the appropriate patch panel.
    b) All System "outputs" or backbone cable connections shall appear on the "bottom" row of connectors of the same patch panel.

4) In order to achieve a high level of reliability that approximates that of an OEM connector, field installable connectors shall have an OEM specified physical contact polish. Every fiber cable shall be terminated with the appropriate connector, and tested to ensure compliance to OEM and specifications outlines herein**.** Where a local fiber optic system connector standard, Industry Standard fiber optic "LC" female connector terminated with a fiber optic cable, shall be used. But, if the fiber optic cable is not used (or "dark"), a "LC" male terminating "cap" shall be provided for each unused "LC" female connector.

g. VCCS and Horizontal Cross-connecting (HCCS) Systems: Each TC shall be provided with a separate VCCS and HCCS located within the TC. The VCCS and HCCS shall interconnect and interface the riser (vertical) trunk line cables with the horizontal (or station) sub-trunk line cables. The media used in the CCS system shall be designed according to the System requirements, OEM standards and guidelines, and as described herein. A multi-pair copper for voice and data, and separate multiple fiber optic and RF coaxial CCS systems shall be provided as a part of the System.

    1) The UTP, trunk-line cabling systems are that connected between the trunk-lines and Riser VCCS, shall be terminated:

        a) On the "left" or "top" IDC (or 110A blocks) for each UTP or STP voice cable.
        b) On the "top" row of RJ45 jacks on the appropriate patch panel for each UTP data cable.

    2) The UTP, distribution cabling systems that are connected between each RTC and each TCO or secondary system distribution or connection point, shall terminate on an appropriate HCCS, at the:

        a) On the "right" IDC used as the VCCS input for each UTP or STP voice cable.
        b) On the "bottom row of RJ45 jacks on the appropriate patch panel used as the VCCS input for each UTP or STP data cable.
        c) The technical requirements of the VCCS and HCCS "patch", "terminating", or "breakout" panels and cable management assemblies for voice, data cables shall be as described in the above MCCS, IMCCS, and TC technical paragraphs.

3) The Contractor shall not “cross-connect” the VCCS or HCCS cabling systems even though appropriate patch cords are provided for each “patch”, “punch”, or “breakout” panel. Also, the Contractor shall not provide active interface or distribution electronic equipment as a part of the System.

h. Distribution Cable Systems / Backbone Cable System (Common to Inter-buildings): The backbone cable system extends from the MCCS to each IMCCS to establish service between buildings on a campus. The media (copper and fiber optic) used in the BC system shall be designed according to the system requirements, OEM standards and guidelines, and as described herein. A multi-pair copper for voice and data, and separate multiple fiber optic backbone system shall be provided as a part of the BC distribution system.

1) All outside cable shall be minimum of STP or UTP, 22 AWG solid conductors, solid PVC insulation, and filled core (flexgel - waterproof Rural Electric Association (REA) LISTED PE 39 CODE) between the outer armor or jacket and inner conductors protective lining.
2) The copper cable system shall be configured as a “Star” Topology with separate dedicated cables between the MCCS and each IMCCS.
3) UTP and STP copper cables shall consist of thermoplastic insulated conductors formed into binder groups. The groups are to be identified by distinctly colored binders and assembled to form a single compact core covered by a protective sheath. Each cable shall be rated for Category 6 Telecommunications System Service. A minimum of eight pairs per circuit, plus an additional 50% spare for growth shall be provided.
4) Where the distance limitations of UTP or STP may be exceeded, multimode (or single mode) fiber optic cable(s) shall be used to augment the voice and/or data backbone cable system(s). The total loss of each fiber shall not exceed 12 decibel (dB) at 850 nano-Meter (nM), 11 dB at 1,300 nM, or 10 dB at 1,500 nM.
5) All voice system “inputs” from the MCCS via the BC distribution system shall appear on the “left” side of IDC (minimum 110 blocks) punch terminals of the IMCCS.
6) All voice system “outputs” or trunk line connections shall appear on the “right” side of the same IDC (minimum 110 blocks) of the IMCCS.
7) All data system “inputs” from the MCCS via the BC distribution system shall appear on the “top” row of jacks of the appropriate patch panel of the IMCCS.
8) All data system “outputs” or trunk line connections shall appear on the “bottom” row of jacks in the same patch panel of the IMCCS.
9) The splitting of pairs within cables between different jacks shall not be allowed. In the case of ISDN and/or ATM and /or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.
10) A patch cord shall be provided for each system “pair” of connection jacks. Each patch cord shall have modular connectors provided on each end to match the panel’s modular female jack.
11) The fiber optic BC system shall be configured as a Star Topology with separate dedicated fibers between the MCCS and each IMCCS. The System shall be sized to meet the system requirements plus an expansion capability of 50%. Fiber optic cable(s) having a minimum of 12 strands multimode fiber and 12 strands single mode fiber shall be provided. Two of the single mode fibers shall be designated for analog video service.

12) All BC shall be identified with permanent labels at both ends. Labels will indicate system, floor, closet, and zone. The label designations shall match those used for cross-connect terminals and patch panels.

i. Distribution (Common to Intra-Building) Cabling Systems: The intra-building trunk cabling system provides for connection between the IMCCS and each Riser TC's provided vertical cross-connecting system (VCCS) within a building. The media (copper, fiber optic and RF coaxial) used in the intra-building backbone cabling system shall be designed according to the system requirements, OEM standards and guidelines, and as described herein. A multi-pair copper for voice and data, and separate multiple fiber optic and analog RF coaxial trunk system shall be provided as a part of the System.

1) Category 6 UTP or STP multi-pair trunk cable(s) shall be used in the voice and data trunk-line-cabling systems. A minimum of eight pairs per circuit, plus an additional 50% spare for growth shall be provided.
2) Where the distance limitations of UTP and/or STP will be exceeded, multimode (or single mode) fiber optic cable shall be used in the voice and/or trunk cabling systems. The total loss of the fiber trunks shall not exceed 12 dB at 850 nM , 11 dB at 1,300 nM, or 10 dB at 1,500 nM.

a) All voice system "outputs" from the IMCCS to the trunk-line distribution system shall appear on the "right" side of IDC (minimum 110A blocks) punch terminals of the IMCCS.
b) All data system "outputs" from the IMCCS to the trunk-line distribution system shall appear on the "bottom" row of jacks of the same IDC (minimum 110A blocks) of the IMCCS.
c) The splitting of pairs within cables between different jacks shall not be allowed. In the case of ISDN and/or ATM and/or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.
d) A patch cord shall be provided for each system "pair" of connection jacks. Each patch cord shall have modular connectors provided on each end to match the panel's modular female jack.

3) The fiber optic trunk line system shall be configured as a Star Topology with separate dedicated fibers between the IMCCS and each RCS. The System shall be sized to meet the System requirements with a expansion capability of 50% provided. Separate individual fiber optic cable(s) with a minimum of 18 strands multimode fiber and/or 12 strands single mode fiber shall be provided. Two of the single mode fibers shall be designated for analog video service.

4) All trunk lines shall be identified with permanent labels at both ends. Labels will indicate system, floor, closet, and zone. The label designations shall match those used for cross-connects and patch panels.

a) All System outputs from the IMCCS to the trunk-line distribution system shall appear on the "bottom" row of "ST" connectors in the appropriate patch panel.
b) A patch cord shall be provided for each system "pair" of connection "ST" connectors. As a minimum, each patch cord shall have "ST" male connectors provided on each end to match the panel's female "ST" connector provided.

5) An analog RF coaxial cable trunk system shall be provided. A minimum of two coaxial cables shall be provided between the IMCCS and each Riser VCCS to comprise an individual circuit as designated and as shown on the drawings. Additional analog RF coaxial cables shall be provided as system design dictates and as shown on the drawings.
6) The analog RF coaxial trunk-line systems shall be connected between each IMCCS “bottom” row of “F” connectors and shall terminate on the VCCS “top” row of “F” connectors on an appropriate patch panel. A minimum of six coaxial cables shall be provided in the riser trunk-line system.

j. Horizontal Cabling (HC): The HC distribution cabling systems connects the distribution field of the voice and data HCCS, in a “Star” Topology, to each TCO or connector and as shown on the drawings via the sub-trunk system.

1) Horizontal cables shall consist of insulated, UTP conductors that are rated for Augmented Category 6 (Category 6A) telecommunications service for voice and data systems.
2) The number of UTP distribution pairs dedicated to each floor from the HC shall be sufficient to accommodate all the horizontal voice and data circuits served by the distribution cable to each TCO.

a) A minimum of four pairs for voice shall be connected to the “right” side of the IDC that the VCCS “input” connections appear in the RTC.
b) A minimum of two separate sets of four pairs each for data shall be connected to the “bottom” row of RJ45 jacks that the VCCS “input” connections appear in the RTC.

3) The horizontal cable length to the farthest system outlet shall be limited to a maximum of 90M (or 295 ft). These maximum lengths must be derated, adjusted and reduced to include cross-connection and distribution system losses. Additional TC(s) shall be provided on large floor areas of buildings to limit the horizontal distribution to a maximum of 90M (or 295 ft).
4) The splitting of pairs within a cable between different jacks shall not be permitted.
5) The installation of the HC shall conform to appropriate OEM recommendations and standards outlined herein. This requirement will insure adequate protection for Electro-Magnetic Interference (EMI) sources.
6) A system design where “looping” the HC distribution cables from room to room shall not be permitted.

k. System Telecommunication Outlets (TCO): The System shall be capable of receiving the specified telephone (or voice) and data signals acquired from the LEC, FTS contracted carrier and computer system.

1) Each TCO shall consist of four multipin modular RJ45 jacks, two designated for telephone and two for data service. Each TCO with appropriate jacks installed shall be provided by the Contractor in each designated location and as shown on the drawings.
2) The Contractor shall connect each telephone multipin modular RJ45 jack to a separate “right side as you look at it” telephone HC distribution system HCCS IDC patch panel terminating device in each associated RTC. The modular RJ45 jack shall be able to accept and operate with smaller modular RJ11 plugs while providing proper connection and not damaging the modular jack. The OEM shall warrant all modular RJ45jacks in such a manner to be usable for modular RJ11 plugs.

3) The Contractor shall connect each TCO data multipin modular RJ45 jack to a separate lower row jack on the HCCS "patch panel" in each associated RTC. The Contractor is not to "cross-connect" VCCS and HCCS data distribution cables or provides active electronic data distribution equipment as a part of the System.
4) A non-impact termination method, using either a stuffer cap with installation tool or full-cycle terminating tool having both tactile and audible feedback to indicate proper termination shall be used. High impact installation tools shall not be used.
5) Each terminated conductor end shall be properly trimmed to assure a minimum clearance of 6.35 mm (0.250 in) clearance between the conductors of adjacent modules.
6) The multipin RJ45 jack shall be modular in construction that will accept and operate with a modular UTP RJ45 connector and its pin assignments.

B. System Performance:

1. At a minimum, the System shall be able to support the following voice for Category 6 and data for Augmented Category 6 (Category 6A) Certified Telecommunication Service in accordance with ANSI/TIA/EIA-568C and the following applications:

a. Provide the following interchange (or interface) capabilities:

1) Basic Rate (BRI).
2) Primary Rate (PRI).

b. ISDN measured at

1) Narrow Band BRI.

a) B Channel: 64 kilo-Bits per second (kBps), minimum.
b) D Channel: 16 kBps, minimum.
c) H Channel: 384 kBps, minimum.

2) Narrow Band PRI:

a) B Channel: 64 kBps, minimum.
b) D Channel: 64 kBps, minimum.
c) H Channel: 1,920 kBps, minimum.

3) Wide (or Broad) Band:

a) All channels: 140 mega(m)-Bps, minimum, capable to 565 mBps at "T" reference.

c. ATM operation and interface: ATM 155 mBps
d. Frame Relay: All stated compliance's
e. Integrated Data Communications Utility (IDCU) operation and interface:
f. Government Open Systems Interconnection Profile (GOSSIP) compliant:
g. Fiber optic Distributed Data Interface (FDDI): A minimum 100 mBps to a maximum of 1.8 giga(g)-Bps data bit stream speed (shall be Synchronous Optical Network [Sonet] compliant).

2. At a minimum the System shall support the following operating parameters:

   a. EPBX connection:

      1) System speed: 1.0 gBps per second, minimum.
      2) Impedance: 600 Ohms.
      3) Cross Modulation: -60 deci-Bel (dB).
      4) Hum Modulation: -55 Db.
      5) System data error: 10 to the -10 Bps, minimum loss measured at the frame output with reference Zero (0) decibel measured (dBm) at 1,000 Hertz (Hz) applied to the frame input.

         a) Trunk to station: 1.5 dB, maximum.
         b) Station to station: 3.0 dB, maximum.
         c) Internal switch crosstalk: -60 dB when a signal of ± 10 deciBel measured (dBm), 500-2,500 Hz range is applied to the primary path.
         d) Idle channel noise: 25 dBm “C” or 3.0 dBm “O” above reference (terminated) ground noise, whichever is greater.
         e) Traffic Grade of Service for Voice and Data:

            (1) A minimum grade of service of P-01 with an average traffic load of 7.0 CCS per station per hour and a traffic overload in the data circuits will not interfere with, or degrade, the voice service.
            (2) Average CCS per voice station: The average CCS capacity per voice station shall be maintained at 7.0 CCS when the EPBX is expanded up to the projected maximum growth as stated herein.

   b. Telecommunications Outlet (TCO):

      1) Voice:

         a) Isolation (outlet-outlet): 24 dB.
         b) Impedance: 600 Ohms, balanced (BAL).
         c) Signal Level: 0 deciBel per mili-Volt (dBmV) ± 0.1 dBmV.
         d) System speed: 100 mBps, minimum.
         e) System data error: 10 to the -6 Bps, minimum.
         f) Interface Resistance: 20 milliohms Initial
         g) Contact Resistance: 2.5 milliohms Insulation
         h) Insulation Resistance: >100 Megohms

      2) Data:

         a) Isolation (outlet-outlet): 24 dB.
         b) Impedance: 600 Ohms, BAL.
         c) Signal Level: 0 dBmV ± 0.1 dBmV.
         d) System speed: 120 mBps, minimum.
         e) System data error: 10 to the -8 Bps, minimum.
         f) Interface Resistance: 20 milliohms Initial
         g) Contact Resistance: 2.5 milliohms Insulation
         h) Insulation Resistance: >100 Megohms

C. General:

1. All equipment to be supplied under this specification shall be new and the current model of a standard product of an OEM or record. An OEM of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied and which:

   a. Maintains a stock of replacement parts for the item submitted.
   b. Maintains engineering drawings, specifications, and operating manuals for the items submitted.
   c. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid.

2. Specifications of equipment as set forth in this document are minimum requirements, unless otherwise stated, and shall not be construed as limiting the overall quality, quantity, or performance characteristics of items furnished in the System. When the Contractor furnishes an item of equipment for which there is a specification contained herein, the item of equipment shall meet or exceed the specification for that item of equipment.
3. The Contractor shall provide written verification, in writing to the RE at time of installation, that the type of wire/cable being provided is recommended and approved by the OEM. The Contractor is responsible for providing the proper size and type of cable duct and/or conduit and wiring even though the actual installation may be by another subcontractor.
4. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications.
5. All interconnecting twisted pair, cables shall be terminated on Patch panels and unused equipment ports shall be terminated according to the OEM's instructions for telephone cable systems without adapters. 9. Color code all distribution wiring to conform to the Telephone Industry standard, EIA/TIA, and this document, which ever is the more stringent. At a minimum, all equipment, cable duct and/or conduit, enclosures, wiring, terminals, and cables shall be clearly and permanently labeled according to and using the provided record drawings, to facilitate installation and maintenance.
6. All equipment faceplates utilized in the System shall be stainless steel, anodized aluminum, or UL approved cycolac plastic for the areas where provided.

2.2 DISTRIBUTION EQUIPMENT AND SYSTEMS

A. Telecommunication Outlet (TCO):

1. The TCO shall consist of two telephone multipin jacks and two data multipin jacks mounted in a steel outlet box. A separate 100mm (4in.) x 100mm (4in.) x 63mm (2.5in.) steel outlet box with a labeled stainless steel faceplate will be used. A second 100mm (4in.) x 100mm (4in.) x 63mm (2.5in.) steel outlet box with a labeled faceplate shall be provided as required adjacent to the first box to ensure system connections and expandability requirements are met.
2. All telephone multipin connections shall be RJ-45 compatible female types. All data multipin connections shall be RJ-45 female types. The TCO shall be fed from the appropriate CCS located in the respective RTC in a manner to provide a uniform and balanced distribution system.
3. Interface of the data multipin jacks to appropriate patch panels (or approved "punch down" blocks) in the associated RTC, is the responsibility of the Contractor. The Contractor shall not extend data cables from the RTCs to data terminal equipment or install data terminal equipment.

4. The wall outlet shall be provided with a stainless steel or approve alternate cover plate to fit the telephone multipin jack, data multi- pin and the outlet box provided (100mm (4in.) x 100mm (4in.) for single and 100mm (4in.) x 200mm (8in.) for dual outlet box applications). For PBPU installations, the cover plate shall be stainless steel.
5. The wall outlet shall be provided with a stainless steel or approve alternate cover plate to fit the telephone multipin jack and data multi- pin jacks and the outlet box provided (100mm (4in.) x 100mm (4in.) for single and 100mm (4in.) x 200mm (8in.) for dual outlet box applications). For PBPU installations, the cover plate shall be stainless steel.

B. Distribution Cables: Each cable shall meet or exceed the following specifications for the specific type of cable. Each cable reel shall be sweep tested and certified by the OEM by tags affixed to each reel. The Contractor shall turn over all sweep tags to the RE or PM. Additionally, the Contractor shall provide a 610 mm (2 ft.) sample of each provided cable, to the RE and receive approval before installation. Cables installed in any outside location (i.e. above ground, under ground in conduit, ducts, pathways, etc.) shall be filled with a waterproofing compound between outside jacket (not immediately touching any provided armor) and inter conductors to seal punctures in the jacket and protect the conductors from moisture.

1. Telephone/Cable:

   a. The System cable shall be provided by the Contractor to meet the minimum system requirements of Category Six (CAT 6) service. The cable shall interconnect each part of the system. The cable shall be completely survivable in areas where it is installed.
   b. Technical Characteristics:

Length	As required, in 1K (3,000 ft.) reels minimum
Cable	Voice grade category six
Connectors	As required by system design
Size	22 AWG, minimum, Outside 24 AWG, minimum, Inside
Color coding	Required, telephone industry standard
Bend radius	10X the cable outside diameter
Impedance	120 Ohms ± 15%, BAL
Shield coverage	As required by OEM specification
Attenuation	
Frequency in mHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
62.0	52.0
100.0	68.0

2. Data Multi-Conductor Cable:

   a. The cable shall be multi-conductor, unshielded cable with solid conductors. The cable shall be able to handle the power and voltage used over the distance required. It shall meet Augmented Category 6 (CAT 6A) service.

b. Technical Characteristics:

Wire size	22 AWG, minimum
Working shield	350 V
Bend radius	10X the cable outside diameter
Impedance	100 Ohms ± 15%, BAL
Bandwidth	100 mHz, minimum
DC RESISTANCE	10.0 Ohms/100M, maximum
Shield coverage	
Overall Outside (if OEM specified)	100%
Individual Pairs (if OEM specified)	100%
Attenuation	
Frequency in mHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
62.0	52.0
100.0	68.0
250.0	74.0
600.0	125.0

3. Fiber Optic Cable:

a. Multimode Fiber:

1) The general purpose multimode fiber optic cable shall be a dual window type installed in conduit for all system locations. A load-bearing support braid shall surround the inner tube for strength during cable installation.

b. Each Single-Mode Fiber shall be:

1) Class IVa dispersion - unshifted single mode optical fibers with Low Water Peak complying with ANSI/EIA/TIA-492CAAB-2000.
2) The zero dispersion wavelength shall be between 1300 nm and 1320 nm. The ANSI/EIA/TIA-455-168 maximum value of the dispersion slope shall be no greater than 0.090 ps/km-nm^2. Dispersion measurements shall be made in accordance with ANSI/EIA/TIA-455-169 or ANSI/EIA/TIA-455-175-B.
3) The nominal mode field diameter shall be 9.1 μm with a tolerance of ± 0.4 μm at 1310 nm when measured in accordance with ANSI/EIA/TIA-455-191-B.
4) The cabled cutoff wavelength shall be ≤1260 nm when measured in accordance with ANSI/EIA/TIA-455-80-C

c. Each OM4 Multimode Fiber shall be:

1) Graded-index optical fiber wave-guide with nominal 50/125μm-core/cladding diameter.
2) The fiber shall comply with the latest revision of ANSI/EIA/TIA-492AAAD.
3) Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-78.

4) Information transmission capacity shall be measured in accordance with the latest revision of ANSI/EIA/TIA-455-204 or –455-220.
5) Maximum cabled attenuation dB/Km @ 850/1300 nm: 3.0/1.0
6) EMB Bandwidth 4700 MHz-km @ 850nm per TIA-455-220
7) OFL Bandwidth 3500 MHz-km @ 850nm per TIA-455-204
8) OFL Bandwidth 500 MHz-km @ 1300nm per TIA-455-204

4. Public Address and/or General Purpose Audio:

a. The audio cable shall be two-conductor, STP cable with stranded conductors. The cable shall be able to handle the power used for the load impedance over the distance required, with not more than 5% power loss. This cable is to be provided in local PA areas only and is not to be used as a part of the telephone system.

b. Technical Characteristics:

Impedance	70.7VRMS audio signal
Wire size	20 AWG, minimum
Working shield	350 V
Color coding	Required, EIA audio industry standard
Connectors	As required
Bend radius	10X the cable outside diameter
Impedance	100 Ohms ± 15%, BAL
Bandwidth	20 mHz, minimum
DC resistance	10.0 Ohms/100M (330 ft.), maximum
Shield coverage	
Overall Outside (if OEM specified)	100%
Individual Pairs (if OEM specified)	100%
Attenuation	
Frequency in mHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0

C. Outlet Connection Cables:

1. Telephone:

a. The Contractor shall provide a connection cable for each TCO telephone jack in the System with 10% spares. The telephone connection cable shall connect the telephone instrument to the TCO telephone jack. The Contractor shall not provide telephone instrument(s) or equipment.

b. Technical Characteristics:

Length	1.8M (6ft.), minimum
Cable	Cat6
Connector	RJ-11/45 compatible male on each end
Size	24 AWG, minimum
Color coding	Required, telephone industry standard

2. Data:

a. The Contractor shall provide a connection cable for each TCO data jack in the system with 10% spares.

The data connection cable shall connect a data instrument to the TCO data jack. The Contractor shall not provide data terminal(s)/equipment.

b. Technical Characteristics:

Length	1.8M (6 ft.), minimum
Cable	Data grade Augmented Category 6 (Category 6A)
Connector	RJ-45 male on each end
Color coding	Required, data industry standard
Size	24 AWG, minimum

3. Modular (RJ-45): The connectors shall be commercial types for voice and high speed data transmission applications. The connector shall be compatible with telephone instruments, computer terminals, and other type devices requiring linking through the modular telecommunications outlet to the System. The connector shall be compatible with UTP cables.

a. Technical Characteristics:

Type	Number of Pins
RJ-45	Eight
Dielectric	Surge
Voltage	1,000V RMS, 60 Hz @ one minute, minimum
Current	2.2A RMS @ 30 Minutes or 7.0A RMS @ 5.0 seconds
Leakage	100 μA, maximum
Connectability	
Initial contact resistance	20 mili-Ohms, maximum
Insulation displacement	10 mili-Ohms, maximum
Interface	Must interface with modular jacks from a variety of OEMs. RJ-11/45 plugs shall provide connection when used in RJ-45 jacks.
Durability	200 insertions/withdrawals, minimum

D. Distribution Frames:

1. A new stand-alone (i.e., self supporting, free standing) MDF shall be provided to interconnect the EPBX and computer room. The MDF shall be modular and equipped with modular terminating mini blocks, and patch panels that are as small as possible and provide all the requirements of this specifications as described herein.
2. All cable distribution closets and MDFs shall be wired in accordance with industry standards and shall employ "latest state-of-the-art" modular cross-connect devices.
3. The MDF and all intermediate distribution frames shall be connected to the EPBX system ground.
4. Technical Characteristics:

Telephone	
IDC type unit	As described in Part 2
Contact wires	50 micron of Gold over Nickel
Contact pressure	100 Grams, MIN
110A Punch blocks	Acceptable alternate to IDC
Data	110A blocks as described in Part 2
Fiber Optic	Patch Panel as described in Part 2

5. General Purpose Analog RF:

   a. The coaxial cable shall be an RG-6/U type (or equal), minimum and shall be increased in size (i.e. RG-ll/U, .500", .750", etc.) as required to meet system design. It may also be used for baseband signals as approved by the OEM.
   b. Technical Characteristics:

Impedance	75 OHM, UNBAL
Center conductor 20 AWG, solid or stranded copper, or copper plated steel or aluminum	
Dielectric	Cellular polyethylene
Shield coverage	95%, copper braid
Connector type	BNC or UHF
Attenuation	
Frequency (k or mHz)	Maximum dB/30.5M (100ft.)
10 kHz	0.20
100 kHz	0.22
1.0 kHz	0.25
4.5 mHz	0.85
10.0 mHz	1.40
100 mHz	5.00

6. Public Address and/or General Purpose Audio:

   a. The audio cable shall be two-conductor, STP cable with stranded conductors. The cable shall be able to handle the power used for the load impedance over the distance required, with not more than 5% power loss. This cable is to be provided in local PA areas only and is not to be used as a part of the telephone system.
   b. Technical Characteristics:

Impedance	70.7VRMS audio signal
Wire size	20 AWG, minimum
Working shield	350 V
Color coding	Required, EIA audio industry standard
Connectors	As required
Bend radius	10X the cable outside diameter
Impedance	100 Ohms $\pm$ 15%, BAL
Bandwidth	20 mHz, minimum
DC resistance	10.0 Ohms/100M (330 ft.), maximum
Shield coverage	
Overall Outside (if OEM specified)	100%
Individual Pairs (if OEM specified)	100%
Attenuation	
Frequency in mHz	dB per 305 M (1,000ft.), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0

7. General Purpose Analog Video:

   a. The coaxial cable shall be an RG-59/U type (or equal), minimum. It may also be used for baseband signals as approved by the OEM.
   b. Technical Characteristics:

Impedance	75 Ohm, UNBAL
Center conductor	20 AWG, SOLID OR STRANDED COPPER
Dielectric	Cellular polyethylene
Shield coverage	95%, copper braid
Connector type	BNC
Attenuation	
Frequency (k or mHz)	Maximum dB/30.5M (100ft.)
10 kHz	0.20
100 kHz	0.22
1.0 kHz	0.25
4.5 mHz	0.85
10.0 mHz	1.40
100 mHz	5.00

8. DAS Analog RF:

   a. The coaxial cable shall be half inch minimum and shall increase in size as required to meet the design.

Inner Conductor	Solid BCCAI
Dielectric	Foam PE
Outer Conductor	AL Tape
Overall Braid	Tinned Copper
Jacket	CMR / CMP
Bend Radius: Installation:	 1.25 inches
Repeated	5 inches
Impedance	50 OHMS
Shielding Effectiveness	> 90 dB
DC Resistance: Inner Conductor Outer Conductor	 .82 OHMS / 1000 ft. 1.27 OHMS / 1000 ft.

2.3 EQUIPMENT ITEMS

A. Server Cabinets:

1. The provided equipment cabinet shall be lockable, fabricated of heavy 16 gauge (ga) steel, and have fully adjustable internal equipment mounting racks or rails that allows front panel equipment mounting and access. It shall have baked-on iron phosphate primer and baked enamel paint finish in a color to be selected by the using Facility Service Chief. It shall be floor or wall mounted with knock-out holes for cable entrance and conduit connection, contain ventilation ports and a quiet fan with non disposable air filter for equipment cooling. Two keys shall be provided to the RE for each lock when the VA accepts the System.

2. Blank panels shall be color matched to the cabinet, aluminum with vertical dimensions in increments of 1I, 2U, 4U and 8U rack units with mounting holes spaced to correspond to 19in. rack dimensions. One blank 45 mm (1.75in.) high blank panel shall be installed between each item of equipment. Provide 30 RU blank panels per cabinet.
3. Provide (10 10-32 hardware kit mounting hardware per cabinet.
4. Provide (2) vertical cable organizer, zero U, per cabinet.
5. Technical Characteristics:

Overall Height	78.40 inches (1991 mm)
Overall Depth	42.13 inches (1070 mm)
Overall Width	29.53 inches (750 mm)
Hole Spacing	per EIA and Industry Standards

6. Internal Cabinet Components (minimum required):

    a. Basic Rack PDU:

        1) Provide (2) basic rack PDU strips per server cabinet. Shall be provided as directed by the RE or the IRM. Each strip shall be mounted inside and at the rear of the cabinet. It shall contain grounded AC outlets for distributing AC power to the installed electronic equipment. The strip shall be self-contained in a metal enclosure and may be provided with a 2 M (6 ft.) long (maximum) connecting cord with three prong plug.
        2) Technical Characteristics:

            a) Power Rating – 208V, 3 Phase, 5.7kW
            b) Input – NEMA L21-20P
            c) Output – (42) NEMA 5-50R

B. In Row Server Cabinet Cooler

1. Summary

    a. The environmental control system shall be designed specifically for precision temperature control applications. It will automatically monitor and control cooling and filtering functions for the conditioned space. The system shall be built to the highest quality engineering and manufacturing standards, and shall be floor mounted and configured for horizontal airflow, with draw-through air pattern, to provide uniform air distribution over the entire face of the coil.

2. Design Requirements

    a. The system shall be as described in the following specification.

        1) Total net cooling capacity: 17.9 (61,000) kW (MBH).
        2) Sensible net cooling capacity: 17.9 (61,000) kW (MBH).
        3) Return air dry bulb temperature: 29.4 (85) º C (º F) DB.
        4) Return air wet bulb temperature18.1 (64.5) º C (º F) WB.
        5) Air Volume: 1368.6 (2900) L/s (CFM).
        6) Electrical supply: 208V, 3 Phase, 60Hz.

3. Submittals

   a. Submittals shall be provided with the proposal and shall include: capacity data, electrical data, physical data, and electrical connection drawing, and piping connection drawing.

4. Quality Assurance

   a. The system shall be completely factory-tested prior to shipment. Testing shall include, but not be limited to: complete pressure and leak testing to ensure system integrity, “Hi-Pot” test, and controls calibration and settings. Each system shall ship with a completed test report to verify completion of factory testing procedure. The system shall be NTRL listed, MCA, and electrical system shall be UL Listed to UL 1995 and CSA 22.2 No. 236

5. Warranty

   a. System parts shall be warranted for a period of 18 months from date of shipment and 12 months from startup.

6. Product Standard Components

   a. Cabinet Construction

      1) Exterior panels shall be 18 gauge metal with 80 kg/m3 (5 lb/ft3) density foam insulation. Insulation complies with UL94-5VA ASTM E84 flame spread and smoke developed rating of 25/50. Front and rear exterior panels shall be 18 gauge perforated steel with 69.5% open free area, and equipped with a keyed lock to provide a means of securing access to the internal components of the unit.
      2) The frame shall be constructed of 16 gauge formed steel welded for maximum strength. All units shall provide full service from the front and rear, allowing units to be placed within a row of racks.
      3) All exterior panels and frame shall be powder coated for durability and attractive finish. Exterior frame and panel color shall have color values: L =74.50, a = -.53, b = +8.20.
      4) Units shall include casters and leveling feet to allow ease of installation in the row and provide a means to level the equipment with adjacent IT racks.

   b. Variable Speed Fans

      1) Fan: The unit shall be configured for draw-through air pattern to provide uniform air flow over the entire face of the coil. Each unit shall include eight 200 mm mixed flow direct drive DC axial fans. Each fan assembly should be designed to provide 171.1 l/s (362.5 CFM) for total unit airflow of 1368.6 l/s (2900 CFM).
      2) Variable Speed Fans: Fans shall be variable speed capable of modulating from 30-100%. Fans shall soft start to minimize in-rush current when starting.
      3) Fan protection: Each fan assembly shall consist of a plastic injection molded bezel with integral fan discharge finger guard, Inlet of the fan should include a cage type finger guard,
      4) Operation and Service: The unit should be capable of operation in the event of a fan failure. Fans shall be replaceable while the unit is in operation.

c. Dual power Supplies

1) Power Supplies: The unit shall include two power supplies, each capable of running the unit at 60% capacity in the event of a single power supply failure. Unit power consumption is not to exceed 1100 watts during normal operation.
2) Operation and Service: Power supply shall be user replaceable.

d. A-B Power Input

1) Input Power Feeds: Dual A-B power inputs should be a locking NEMA or IEC plug connection suitable for the input power selected.

e. Microprocessor Controller

1) Monitoring and Configuration: The master display shall allow monitoring and configuration of the air conditioning unit through a menu-based control. Functions include status reporting, set-up, and temperature set points. Four LEDs report the operational status of the connected air conditioning unit.
2) Controls: The microprocessor controller shall come equipped with control keys to allow the user to navigate between menus, select items, and input alphanumeric information.

Voltage	kAIC
200-240V 50/60Hz	50
380-415V 50Hz	36
460-480V 60Hz	22

3) Alarms: The microprocessor controller shall activate a visible and audible alarm in the occurrence of the following events:

a) Internal Communications Fault
b) Link Isolation Relay Fault
c) Cooling Failure
d) Rack Inlet High Temperature
e) Rack Inlet Temperature Sensor Fault
f) Air Filter Clogged
g) Lower Return Air Temperature Sensor Fault
h) Upper Return Air Temperature Sensor Fault
i) Lower Supply Air Temperature Sensor Fault
j) Upper Supply Air Temperature Sensor Fault
k) Coil Fluid Valve Actuator Fault
l) Fan Fault
m) Fan Run Hours Exceeded
n) Water Detection Fault
o) Condensate Pump Fault
p) Condensate Run Hours Exceeded
q) Fluid Flow Meter Fault
r) Entering Fluid High Temperature
s) Entering Fluid Temperature Sensor
t) Leaving Fluid Temperature Sensor
u) Condensate Pan Full Alarm
v) Power Feed Failure
w) Fan Power Supply Fault

x) Air Filter Run Hours Exceeded
y) Supply Air High Temperature
z) Return Air High Temperature
aa) Group Communication Lost
bb) Input Contact Fault
cc) Invalid Supply Setpoint
dd) Filter Sensor Fault

4) Logging: The microprocessor controller shall log and display all available events. Each alarm log shall contain a time/date stamp as well as operating conditions at the time of occurrence. The controller shall display the run time hours for major components.

f. Network Management Card

1) The unit shall include a Network Management Card to provide management through a MODBUS MSTP connection. Management through the network should include the ability to change/monitor set points as well as view and clear alarms.

g. Cooling Coil and Condensation Pan

1) Cooling coil shall use a raised lance type aluminum fin and 9.5-mm (3/8-in OD) copper tube coils. Coil end supports shall be a minimum 18 gauge galvanized steel. Coil shall be rated for a maximum pressure of 2757.9 kPa (400 psig).
2) The unit shall consist of a primary and secondary drain pan. The secondary drain pan shall be piped to the primary pan for removal of condensate. The primary drain pan shall include a condensate pump and dual floats for control and overflow protection.

h. 2/3-Way Modulating Valve

1) A floating point valve shall be microprocessor controlled to automatically direct the proper amount of chilled water in the cooling coil to maintain optimal conditions. A shut-off valve located in the bypass line may be manually adjusted for two-way flow.
2) The three way control valve shall be rated for 300 WOG with brass body and stainless steel ball.
3) Valve Actuator: The actuator shall be a direct connect rotary floating point style actuator with potentiometer feedback, and should be capable of being replaced without disconnecting piping from the valve. Ability for manual operation is also provided.

i. Condensate Pump

1) The factory-installed condensate pump is piped internally to the condensate pan. It is capable of pumping 5 L/h (1.3 GPH) liquid a maximum distance of 15.2 m (50 ft), which may include a maximum lift of 4.9 m (16 ft). Dual floats are included with the unit. One float is used for condensate pump control, the other to generate condensate pan overflow alarms.

j. Filters

1) The standard air filter shall be <20% efficient per ASHRAE 52.1, MERV 1 per ASHRAE 52.2, 1/2-in washable mesh filter.
2) The optional air filter shall be high capacity 2-in pleated, UL 900 Class 2, Moisture with average atmospheric dust spot efficiency of 30% per AHRAE Standard 52.1, MERV 8 per ASHRAE 52.2.

k. Selectable Top or Bottom Piping

1) Pipe connections for field connection from either the top or bottom of the unit. Unit connections shall be made internal to the unit.
2) Series Pipe adapter: The unit shall include two pipe adapters that convert a 25.4 mm (1 in) NPT male to a 25.4 mm (1 in) BSPT female (manufactured in accordance with BS21). Pipe adapters shall ship loose with the unit for field installation where applicable.

l. Remote Temperature Sensor

1) One remote temperature sensor shall be shipped with the unit for placement in the field to provide control input based on rack inlet temperature.

m. Flow Meter

1) The flow meter shall be factory piped inside the unit and connected to microprocessor controls to provide water flow rate through the unit. The microprocessor controller shall also use this information to provide total unit capacity out of the unit while in operation.
2) The flow meter shall be a stainless steel construction turbine type meter, compatible with glycol/water solutions up to 50%, with accuracy of 1.5% or better within the range of 5-50 GPM.

n. Cable Water Detector

1) The flow meter shall be factory piped inside the unit and connected to microprocessor controls to provide water flow rate through the unit. The microprocessor controller shall also use this information to provide total unit capacity out of the unit while in operation.
2) The flow meter shall be a stainless steel construction turbine type meter, compatible with glycol/water solutions up to 50%, with accuracy of 1.5% or better within the range of 5-50 GPM.

o. Bridge Power Cable Trough

1) An overhead power distribution bridge that sits between adjacent racks and allows for removal of the unit without disrupting the overhead power cabling, is available as an accessory.
2) The cable trough shall be constructed of 16 gauge cold rolled steel with a black powder coat finish.

p. Bridge Data Partition

1) An overhead cable distribution bridge that sits between adjacent racks and allows for removal of the unit without disrupting overhead cabling, is available as an accessory.
2) The data partition shall be constructed of 16 gauge cold rolled steel with a black powder coat finish.

q. Chilled Water

1) The unit shall be piped in accordance with the highest commercial quality procedures. All PEX-AL-PEX pipe forming shall be tool bent with the proper bend radii to prevent flattening in the curve. The chilled water piping shall be insulated with closed cell elastomer insulation. All piping connections should be made at the rear of the unit for top or bottom accessibility.

C. 19" Open Rack:

1. The rack shall be constructed of heavy 16 gauge cold rolled steel and have fully adjustable equipment front mounting rails that allows front panel equipment mounting and access. It shall have baked-on iron phosphate primer and baked enamel paint finish in a color to be selected by the using Facility Service Chief or the RE. It shall be bolted to the floor.
2. Technical Characteristics:

Overall Height	2180 mm (85 7/8in.), maximum
Overall Depth	650 mm (25 1/2in.), maximum
Overall Width	535 mm (21 1/16in.), maximum
Front Panel Opening	480 mm (19in.), EIA horizontal width
Hole Spacing	per EIA and Industry Standards

D. Cross-Connection System (CCS) Equipment Breakout, Termination Connector (or Bulkhead), and Patch Panels:

1. The connector panel(s) shall be made of flat smooth 3.175 mm (1/8 in.) thick solid aluminum, custom designed, fitted and installed in the cabinet. Bulkhead equipment connectors shall be mounted on the panel to enable all cabinet equipment's signal, control, and coaxial cables to be connected through the panel. Each panel shall be color matched to the cabinet installed.

a. Voice:

1) The CSS for voice shall be angled, 48 port rack mount patch panels, and shall be specifically designed for Augmented Category 6 (Category 6A) telecommunications service and the size and type of UTP cable used as described herein. These shall be for the voice station/horizontal cabling.
2) 300 pair, CAT 6, 110A blocks shall be used for voice backbone cabling terminations.

b. Digital or High Speed Data:

1) The CSS for digital or high-speed data service shall be an angled patch panel with modular female RJ45 jacks installed in rows. Patch panels and RJ45 jacks shall be specifically designed for Augmented Category 6

(Category 6A) telecommunications service and the size and type of UTP cable used. Each panel shall be 480 mm (19in.) horizontal EIA rack mountable dimensions with EIA standard spaced vertical mounting holes.

2) Technical Characteristics:

Number of horizontal rows	2
Number of jacks per row	48
Type of jacks	RJ45
Insulation	required between each row of jacks

c. Fiber Optic Building Backbone Hardware

1) Fiber optic building backbone shall have each fiber strand terminated with an LC connector in the field.
2) Fiber optic hardware shall be rack Mount, 3 RMU, hold 12 fiber optic coupler/adapter panels (MDA and MDFs).
3) Fiber optic hardware shall be rack Mount, 1 RMU, hold a minimum of 3 fiber optic coupler/adapter panels.
4) Coupler/Adapter panels shall be 12 Strand, 6 Duplex SC for Singlemode fiber.
5) Coupler/Adapter panels shall be 12 Strand, 6 Duplex SC for Multimode fiber Laser optimized (OM-4)
6) Coupler/Adapter panels shall be 24 Strand, 12 Duplex SC for Singlemode fiber.
7) Coupler/Adapter panels shall be 24 Strand, 12 Duplex SC for Multimode fiber Laser optimized (OM-4)
8) Provide Blank coupler panel plates on unused position on all fiber optic hardware

d. Fiber Optic Hardwire Main Computer Room MDA Racks to Main Computer Room Server Cabinets.

1) Main Computer Room MDA Rack to each Main Computer Room Server cabinet shall be a cassette/module based system using MTP connectors on the rear of each cassette and Duplex LC connectors on the front panel. Cassette/Modules may use Method A or Method B cabling as defined in TIA/EIA-568-C. The MTP cassettes/modules will provide an easy migration to 40G and 100G transmission in the Main Computer Room.
2) NOTE: Installer shall clarify the chosen Method A or Method B cabling method in their project submittal. Each manufacturer uses a different Method (A or B).
3) Each Cassette/Module in the MDA Rack shall be connected to each cassette/module in each Main Computer Room server cabinet with an MTP trunk cable. Installer to size and provide all MTP trunk cables. MTP trunk cables shall be female pinned.
4) Fiber optic hardware shall be rack Mount, 3 RMU, hold 12 fiber optic cassette/modules (MDA Racks). Each 3 RMU fiber optic hardware shall support four (4) Main Computer Room Server cabinets.
5) Fiber optic hardware shall be rack Mount, 1 RMU, hold a minimum of 3 fiber optic cassette/modules. (Main Computer Room server cabinets).
6) Cassette/module shall be one (1) MTP male pinned connector on rear with 6 Duplex LC (12 Strand) Multimode Laser Optimized (OM-3) connectors on the front. Provide two (2) at each main Computer Room Server cabinet.

7) Cassette/module shall be two (2) MTP male pinned connector on rear connected to two (2) 6 Duplex LC (12 Strand) Multimode Laser Optimized (OM-3) connectors on the front. Provide one (1) at each main Computer Room Server cabinet.

d. Mounting Strips and Blocks:

1) Barrier Strips: Barrier strips are approved for AC power, data, voice, and control cable or wires. Barrier strips shall accommodate the size and type of audio spade (or fork type) lugs used with insulating and separating strips between the terminals for securing separate wires in a neat and orderly fashion. Each cable or wire end shall be provided with an audio spade lug, which is connected to an individual screw terminal on the barrier strip. The barrier strips shall be surface secured to a console, cabinet, rail, panel, etc. 120 VAC power wires shall not be connected to signal barrier strips.

2) Technical Characteristics:

Terminal size	6-32, minimum
Terminal Count	ANY COMBINATION
Wire size	20 AWG, minimum
Voltage handling	100 V, minimum
Protective connector cover	Required for Class II and 120 VAC power connections

e. “BNC” Type:

1) The BNC connector shall have a bayonet locking coupling for quick connect/disconnect of coaxial cable/terminations. It shall be a crimp-on (twist on are acceptable) connector designed to fit the coaxial cable furnished.

2) Technical Characteristics:

Impedance	50 or 75 Ohms, UNBAL
Working Voltage	500 V

f. “F” Type:

1) The “F” connector shall have a screw type coupling for quick connect/disconnect of coaxial cable/terminations. It shall be a crimp-on connector designed to fit the coaxial cable furnished with integral 12.7 mm (½in.) ferrule.

2) Technical Characteristics:

Impedance	75 Ohms, UNBAL
Working Voltage	500 V

E. Terminators:

1. Coaxial:

a. These units shall be metal-housed precision types in the frequency ranges selected. They shall be the screw-on type that has low VSWR when installed and the proper impedance to terminate the required system unit or coaxial cable.

b. Technical Characteristics:

Frequency	0-1 GHz
Power blocking	As required
Return loss	25 dB
Connectors	“F”, "BNC", minimum
Impedance	50 or 75 Ohms, UNBAL

F. Open Bottom CT Open 1 Inch Flange

1. Cable tray shall be made of extruded Aluminum
2. Cable Tray shall be UL Classified, construction and markings are per latest NEMA Standards Pub WE1, CSA C22.2 No.126
3. 1 inch wide box rung spaced 9 inches apart.
4. Cable tray shall have 1 inch open flange
5. Cable tray shall be 6 inch height x 12 inch wide
6. Cable tray shall be 6 inch height x 18 inch wide
7. Cable tray shall be 6 inch height x 24 inch wide
8. Provide and install all required support hardware and fasteners per manufacturer’s instructions.
9. Provide continuous barrier for separation of voice and data cables from nurse call cables.

G. Closed Bottom Cable Tray with Flanged Louvered Cover

1. Cable tray shall be made of extruded Aluminum
2. Cable Tray shall be UL Classified, construction and markings are per latest NEMA Standards Pub WE1, CSA C22.2 No.126
3. Cable tray shall have solid bottom.
4. Cable Tray cover shall be flanged with louvers
5. Cable tray shall have 1 inch open flange
6. Cable tray shall be 6 inch height x 12 inch wide
7. Cable tray shall be 6 inch height x 18 inch wide
8. Cable tray shall be 6 inch height x 24 inch wide
9. Provide and install all required support hardware and fasteners per manufacturer’s instructions.
10. Provide continuous barrier for separation of voice and data cables from nurse call cables.
11. Provide closed button cable tray with flanged louvered cover in all interstitial zones.

H. Open basket Tray

1. Basket type tray shall be made of carbon steel ASTM A510 Grade 1008.
2. Basket type tray shall have an Electroplated Zinc ASTM B633 finish
3. Basket type tray shall be 6 inch height x 12 inch wide
4. Basket type tray shall be 6 inch height x 18 inch wide
5. Basket type tray shall be 6 inch height T x 24 inch wide
6. Provide and install all required support hardware and fasteners per manufacturer’s instructions.
7. Provide continuous barrier for separation of voice and data cables from nurse call cables.

I. Telco Style Cable Runway

1. Cable runway shall be Telco Style.
2. Side stringers shall be 1-1/2” x 3/8”.
3. Cross members shall be ½” x 1”.
4. Color shall be black.

5. Width shall be 12” wide.
6. Provide cable runway corner brackets at inside of all cable runway corners.

2.4 TELECOMMUNCATIONS CLOSET REQUIREMENTS

A. Refer to O I & T Design Guide PG-18-12 and EDM PG-18-10, for specific TC guidelines for size, power input, security, and backboard mounting requirements. It is the Contractors responsibility to ensure TC compliance with the System Requirements.

2.5 ENVIRONMENTAL REQUIREMENTS

A. Technical submittals shall identify the environmental specifications for housing the system. These environmental specifications shall identify the requirements for initial and expanded system configurations for:

1. Floor loading for batteries and cabinets.
2. Minimum floor space and ceiling heights.
3. Minimum size of doors for equipment passage.
4. Power requirements: The bidders shall provide the specific voltage, amperage, phases, and quantities of circuits required.
5. Air conditioning, heating, and humidity requirements. The bidder shall identify the ambient temperature and relative humidity operating ranges required preventing equipment damage.
6. Air conditioning requirements (expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards).
7. Proposed floor plan based on the expanded system configuration of the bidder's proposed EPBX for this Facility.
8. Conduit size requirement (between equipment room and console room).

2.6 INSTALLATION KIT

A. The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. Turn over to the RE all unused and partially opened installation kit boxes, coaxial, fiberoptic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware. The following are the minimum required installation sub-kits:

B. System Grounding:

1. The grounding kit shall include all cable and installation hardware required. All radio equipment shall be connected to earth ground via internal building wiring, according to the NEC.
2. This includes, but is not limited to:

    a. Coaxial Cable Shields.
    b. Control Cable Shields.
    c. Data Cable Shields.
    d. Equipment Racks.
    e. Equipment Cabinets.

f. Conduits.
g. Duct.
h. Cable Trays.
i. Power Panels.
j. Connector Panels.
k. Grounding Blocks.

C. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.

D. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.

E. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.

F. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.

G. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to completely and correctly label each subsystem according to the OEM requirements, as-installed drawings, and this document.

H. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide the system documentation as required by this document and explained herein.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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 catalog numbers, model and serial identification numbers. The RE may inventory the cable, patch panels, and related equipment.
2. Storage and Handling: Store and protect equipment in a manner, which will preclude damage as directed by the RE.

B. System Installation:

1. After the contract’s been awarded, and within the time period specified in the contract, the Contractor shall deliver the total system in a manner that fully complies with the requirements of this specification. The Contractor shall make no substitutions or changes in the System without written approval from the RE and PM.

2. The Contractor shall install all equipment and systems in a manner that complies with accepted industry standards of good practice, OEM instructions, the requirements of this specification, and in a manner which does not constitute a safety hazard. The Contractor shall insure that all installation personnel understands and complies with all the requirements of this specification.
3. The Contractor shall install suitable filters, traps, directional couplers, splitters, TC's, and pads for minimizing interference and for balancing the System. Items used for balancing and minimizing interference shall be able to pass telephone and data signals in the frequency bands selected, in the direction specified, with low loss, and high isolation, and with minimal delay of specified frequencies and signals. The Contractor shall provide all equipment necessary to meet the requirements of Paragraph 2.1.C and the System performance standards.
4. All passive equipment shall be connected according to the OEM's specifications to insure future correct termination, isolation, impedance match, and signal level balance at each telephone/data outlet.
5. Where TCOs are installed adjacent to each other, install one outlet for each instrument.
6. All lines shall be terminated in a suitable manner to facilitate future expansion of the System. There shall be a minimum of one spare 25 pair cable at each distribution point on each floor.
7. All horizontal copper cables shall be terminated so any future changes only requires modifications of the EPBX or signal closet equipment only.
8. Terminating resistors or devices shall be used to terminate all unused branches, outlets, equipment ports of the System, and shall be devices designed for the purpose of terminating fiber optic or twisted pair and lightwave cables carrying telephone and data and analog signals in telephone and data lightwave systems.
9. Equipment installed outdoors shall be weatherproof or installed in weatherproof enclosures with hinged doors and locks with two keys.
10. Equipment installed indoors shall be installed in metal cabinets with hinged doors and locks with two keys.

C. Conduit and Signal Ducts:

1. Conduit:

   a. The Contractor shall employ the latest installation practices and materials. The Contractor shall provide conduit, junction boxes, connectors, sleeves, weatherheads, pitch pockets, and associated sealing materials not specifically identified in this document as GFE. Conduit penetrations of walls, ceilings, floors, interstitial space, fire barriers, etc., shall be sleeved and sealed. The minimum conduit size shall be 1".
   b. All cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow telephone cables to be installed in partitioned cable tray with data cables may be granted in writing by the RE if requested.) Conduits shall be provided in accordance with Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and NEC Article 800 for Communications systems, at a minimum.
   c. When metal, plastic covered, etc., flexible cable protective armor or systems are specifically authorized to be provided for use in the System, their installation guidelines and standards shall be as specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.
   d. When "innerduct" flexible cable protective systems is specifically authorized to be provided for use in the System, it's installation guidelines and standards shall be as the specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.

e. Conduit (including GFE) fill shall not exceed 40%. Each conduit end shall be equipped with a protective insulator or sleeve to cover the conduit end, connection nut or clamp, to protect the wire or cable during installation and remaining in the conduit. Electrical power conduit shall be installed in accordance with the NEC. AC power conduit shall be run separate from signal conduit.

f. When metal, plastic covered, etc., flexible cable protective armor or systems are specifically authorized to be provided for use in the System, their installation guidelines and standards shall be as specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.

D. Distribution System Signal Wires and Cables:

1. Wires and cables shall be provided in the same manner and use like construction practices as Fire Protective and other Emergency Systems that are identified and outlined in NFPA 101, Life Safety Code, Chapters 7, 12, and/or 13, NFPA 70, National Electrical Code, Chapter 7, Special Conditions. The wires and cables shall be able to withstand adverse environmental conditions in their respective location without deterioration. 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.

a. Each wire and cable shall terminate on an item of equipment by direct connection. Spare or unused wire and cable shall be provided with appropriate connectors (female types) that are installed in appropriate punch blocks, barrier strips, patch, or bulkhead connector panels.

2. Routing and Interconnection:

a. Wires or cables between consoles, cabinets, racks and other equipment shall be in an approved conduit, signal duct, cable duct, or cable tray that is secured to building structure.

b. Wires and cables shall be insulated to prevent contact with signal or current carrying conductors. Wires or cables used in assembling consoles, panels, equipment cabinets and racks shall be formed into harnesses that are bundled and tied. Harnessed wires or cables shall be combed straight, formed and dressed in either a vertical or horizontal relationship to equipment, controls, components or terminations.

c. Harnesses with intertwined members are not acceptable. Each wire or cable that breaks out from a harness for connection or termination shall have been tied off at that harness or bundle point, and be provided with a neatly formed service loop.

d. Wires and cables shall be grouped according to service (i.e.: AC, grounds, signal, DC, control, etc.). DC, control and signal cables may be included with any group. Wires and cables shall be neatly formed and shall not change position in the group throughout the conduit run. Wires and cables in approved signal duct, conduit, cable ducts, or cable trays shall be neatly formed, bundled, tied off in 600 mm to 900 mm (24 in. to 36 in.) lengths and shall not change position in the group throughout the run. Concealed splices are not allowed.

e. Separate, organize, bundle, and route wires or cables to restrict EMI, channel crosstalk, or feedback oscillation inside any enclosure. Looking at any enclosure from the rear (wall mounted enclosures, junction, pull or interface boxes from the front), locate AC power, DC and speaker wires or cables on the left; coaxial, control, microphone and line level audio and data wires or cables, on the right. This installation shall be accomplished with ties and/or fasteners that will not damage or distort the wires or cables. Limit spacing between tied off points to a maximum of 150 mm (6 inches).

f. Do not pull wire or cable through any box, fitting or enclosure where change of cable tray or signal or cable duct alignment or direction occurs. Ensure the proper bend radius is maintained for each wire or cable as specified by it's OEM.

g. Employ temporary guides, sheaves, rollers, and other necessary items to protect the wire or cable from excess tension or damage from bending during installation. Abrasion to wire or cable jackets are not acceptable and will not be allowed. Replace all cables whose jacket has been abraded. The discovery of any abraded and/or damaged cables during the proof of performance test shall be grounds for declaring the entire system unacceptable and the termination of the proof of performance test. Completely cover edges of wire or cable passing through holes in chassis, cabinets or racks, enclosures, pull or junction boxes, conduit, etc., with plastic or nylon grommeting.

h. Cable runs shall be splice free between conduit junction and interface boxes and equipment locations.

i. Cables shall be installed and fastened without causing sharp bends or rubbing of the cables against sharp edges. Cables shall be fastened with hardware that will not damage or distort them.

j. Cables shall be labeled with permanent markers at the terminals of the electronic and passive equipment and at each junction point in the System. The lettering on the cables shall correspond with the lettering on the record diagrams.

k. Completely test all of the cables after installation and replace any defective cables.

l. Wires or cables that are installed outside of buildings shall be in conduit, secured to solid building structures. If specifically approved, on a case by case basis, to be run outside of conduit, the wires or cables shall be installed, as described herein. The bundled wires or cables must: Be tied at not less than 460 mm (18 in.) intervals to a solid building structure; have ultra violet protection and be totally waterproof (including all connections). The laying of wires or cables directly on roof tops, ladders, drooping down walls, walkways, floors, etc. is not allowed and will not be approved.

m. Wires or cables installed outside of conduit, cable trays, wireways, cable duct, etc.

    1) Only when specifically authorized as described herein, will wires or cables be identified and approved to be installed outside of conduit. The wire or cable runs shall be UL rated plenum and OEM certified for use in air plenums.
    2) Wires and cables shall be hidden, protected, fastened and tied at 600 mm (24 in.) intervals, maximum, as described herein to building structure.
    3) Closer wire or cable fastening intervals may be required to prevents sagging, maintain clearance above suspended ceilings, remove unsightly wiring and cabling from view and discourage tampering and vandalism. Wire or cable runs, not provided in conduit, that penetrates outside building walls, supporting walls and two hour fire barriers shall be sleeved and sealed with an approved fire retardant sealant.
    4) Wire or cable runs to system components installed in walls (i.e.: volume attenuators, circuit controllers, signal, or data outlets, etc.) may, when specifically authorized by the RE, be fished through hollow spaces in walls and shall be certified for use in air plenum areas.
    5) Cabling in Level 3 concourse shall be plenum rated.

n. Wires or cables installed in underground conduit, duct, etc.

    1) Wires or cables installed in underground installations shall be waterproofed by the inclusion of a water protective barrier (i.e. gel, magma, etc.) or flooding compound between the outside jacket and first shield.

Each underground connection shall be accessible in a manhole, recessed ground level junction box, above ground pedestal, etc., and shall be provided with appropriate waterproof connectors to match the cable being installed. Once the System has been tested and found to meet the System performance standards and accepted by VA, the Contractor shall provide waterproof shrink tubing or approved mastic to fully encompass each wire or cable connection and overlay at least 150 mm (6 inches) above each wire or cable jacket trim point.

2) It is not acceptable to connect waterproofed cable directly to an inside CCS punch block or directly to an equipment connection port. When an under ground cable enters a building, it shall be routed directly to the closest TC that has been designated as the building's IMTC. The Contractor shall provide a "transition" splice in this TC where the "water proofed" cable enters on one side and "dry" cable exits on the other side. The "transition" splice shall be fully waterproof and be capable of reentry for system servicing. Additionally, the transition splice shall not allow the waterproofing compound to migrate from the water proof cable to the dry cable.

3) Warning tape shall be continuously placed 300 mm (12 inches) above buried conduit, cable, etc.

E. Outlet Boxes, Back Boxes, and Faceplates:

1. Outlet Boxes: Signal, power, interface, connection, distribution, and junction boxes shall be provided as required by the system design, on-site inspection, and review of the contract drawings.
2. Back Boxes: Back boxes shall be provided as directed by the OEM as required by the approved system design, on-site inspection, and review of the contract drawings.
3. Face Plates (or Cover Plates): Faceplates shall be of a standard type, stainless steel, anodized aluminum or UL approved cycolac plastic construction and provided by the Contractor for each identified system outlet location. Connectors and jacks appearing on the faceplate shall be clearly and permanently marked.

F. Connectors: Circuits, transmission lines, and signal extensions shall have continuity, correct connection and polarity. A uniform polarity shall be maintained between all points in the system.

1. Wires:

a. Wire ends shall be neatly formed and where insulation has been cut, heat shrink tubing shall be employed to secure the insulation on each wire. Tape of any type is not acceptable.
b. Audio spade lugs shall be installed on each wire (including spare or unused) end and connect to screw terminals of appropriate size barrier strips. AC barrier strips shall be provided with a protective cover to prevent accidental contact with wires carrying live AC current. Punch blocks are approved for signal, not AC wires. Wire Nut or "Scotch Lock" connectors are not acceptable for signal wire installation.

2. Cables: Each connector shall be designed for the specific size cable being used and installed with the OEM's approved installation tool. Typical system cable connectors include; but, are not limited to: Audio spade lug, punch block, wirewrap, etc.

G. AC Power: AC power wiring shall be run separately from signal cable.

H. Labeling: Provide labeling in accordance with ANSI/EIA/TIA-606-A. All lettering for voice and data circuits shall be stenciled using thermal ink transfer process Handwritten labels are not acceptable.

1. Cable and Wires (Hereinafter referred to as “Cable”): Cables shall be labeled at both ends in accordance with ANSI/EIA/TIA-606-A. Labels shall be permanent in contrasting colors. Cables shall be identified according to the System “Record Wiring Diagrams”.
2. Equipment: System equipment shall be permanently labeled with contrasting plastic laminate or bakelite material. System equipment shall be labeled on the face of the unit corresponding to its source.
3. Termination Hardware: The Contractor shall label workstation outlets and patch panel connections using color coded labels with identifiers in accordance with ANSI/EIA/TIA-606-A and the “Record Wiring Diagrams”.
4. Exposed Conduits: Label all exposed telecommunication conduits every 8’-0”.

3.2 TESTS

A. Interim Inspection:

1. This inspection shall verify that the equipment provided adheres to the installation requirements of this document. The interim inspection will be conducted by a factory-certified representative and witnessed by a Government Representative. Each item of installed equipment shall be checked to insure appropriate UL certification markings. This inspection shall verify cabling terminations in telecommunications rooms and at workstations adhere to color code for T568A pin assignments and cabling connections are in compliance with ANSI/EIA/TIA standards. Visually confirm Augmented Category 6 (Category 6A) marking of outlets, faceplates, outlet/connectors and patch cords.
2. Perform fiber optical field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.
3. The Contractor shall notify the RE, in writing, of the estimated date the Contractor expects to be ready for the interim inspection, at least 20 working days before the requested inspection date.
4. Results of the interim inspection shall be provided to the RE and PM. If major or multiple deficiencies are discovered, a second interim inspection may be required before permitting the Contractor to continue with the system installation.
5. The RE and/or the PM shall determine if an additional inspection is required, or if the Contractor will be allowed to proceed with the installation. In either case, re-inspection of the deficiencies noted during the interim inspection(s), will be part of the proof of performance test. The interim inspection shall not affect the Systems’ completion date. The Contracting Officer shall ensure all test documents will become a part of the Systems record documentation.

B. Pretesting:

1. Upon completing the installation of the System, the Contractor shall align and balance the system. The Contractor shall pretest the entire system.
2. Pretesting Procedure:

    a. During the system pretest, the Contractor shall verify (utilizing the approved spectrum analyzer and test equipment) that the System is fully operational and meets all the system performance requirements of this standard.

b. The Contractor shall pretest and verify that all System functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. The Contractor shall measure and record the aural carrier levels of each system telephone and data channel, at each of the following points in the system:

1) Local Telephone Company Interfaces or Inputs.
2) EPBX interfaces or inputs and outputs.
3) MDF interfaces or inputs and outputs.
4) EPBX output S/NR for each telephone and data channel.
5) Signal Level at each interface point to the distribution system, the last outlet on each trunk line plus all outlets installed as part of this contract.

3. The Contractor shall provide four (4) copies of the recorded system pretest measurements and the written certification that the System is ready for the formal acceptance test shall be submitted to the RE.

C. Acceptance Test: After the System has been pretested and the Contractor has submitted the pretest results and certification to the RE, then the Contractor shall schedule an acceptance test date and give the RE 30 day's written notice prior to the date the acceptance test is expected to begin. The System shall be tested in the presence of a Government Representative and an OEM certified representative. The System shall be tested utilizing the approved test equipment to certify proof of performance and Life Safety compliance. The test shall verify that the total System meets the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.

D. Verification Tests:

1. Test the UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has an overall shield. Test the operation of shorting bars in connection blocks. Test cables after termination and prior to cross-connection.

3.3 TELECOMMUNICATION ACCEPTANCE TESTING

A. Each copper cable terminating in a communication outlet jack connector shall be tested from the Main Cross-Connnect room (MCC) or Telecommunications Room (TR) location with a 4-pair Level IV accuracy cable tester. The tester shall verify continuity, faults, reversals, swaps, wiremap, autotest and pairing.

B. Each optical fiber strand will be tested end-to-end in both directions (Bi-Directional) and at multiple wavelengths.

C. 100% of all cables, pairs, connected strands, connected jacks and panel connections shall be tested.

D. Any failed test links or segments will require remedial action until the failed link or segment passes the performance test.

E. Test results shall be submitted in hard copy and electronic formats within 7 days of completion of the testing.

F. Category 6 UTP

1. The Permanent Link test configuration shall be used to verify the performance of the installed cabling.
2. Each cable terminating in a Telecommunication Outlet shall be tested from the MCC or TR with a 4-pair Level IV accuracy cable tester. The baseline accuracy of the test equipment shall exceed TIA Level IV, as indicated by independent laboratory testing. The cable tester shall be calibrated once a year. Provide proof of current calibration with hard copy test results.
3. The test equipment shall be capable of certifying Category 6 links Category 6A links in accordance with ANSI/TIA/EIA- 568-C Category 6 and 6A parameters.
4. Each Category 6 cable link (Permanent Link) voice shall be tested for near-end and insertion Loss and shall be verified for acceptable length. The Contractor shall warrant performance based on Category 6 referenced standards for Permanent Link performance and provide patch cords that meet channel performance.
5. All cabling not tested strictly in accordance with these specifications shall be re-tested at no additional cost to the Owner.
6. 100% of the installed cabling must be tested and all tests must pass the acceptance criteria as defined herein.
7. All test reports shall include the following information for each cabling element tested:

    a. Wiremap results that indicate the cabling has no shorts, opens, miswires, split, reversed, or crossed pairs and end-to-end connectivity is achieved.
    b. Tests shall be performed in a swept frequency manner from 1 to 250 MHz. Information shall be provided for all pairs or pair combinations and in both directions. Any individual test that fails the relevant performance specifications shall be marked as FAIL.
    c. For Category 6 cabling, Insertion Loss, NEXT, PSNEXT, Return Loss, ACR-F Loss, PS-ACR-F Loss data that include the worst case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1MHz to highest relevant frequency, using a swept frequency interval that is in accordance with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
    d. Length, propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
    e. Cable manufacturer, cable model number/type, and Nominal Velocity of Propagation (NVP).
    f. Tester manufacturer, model, serial number, hardware version, and software version.
    g. Circuit ID number and Project name.
    h. Autotest specification used.
    i. Overall PASS/FAIL indication.
    j. Date of test.

8. Each Category 6A cable link (Permanent Link) Data shall be tested for near-end and Insertion Loss and shall be verified for acceptable length. The Contractor shall warrant performance based on Category 6A referenced standards for Permanent Link performance and provide patch cords that meet channel performance.
9. All cabling not tested strictly in accordance with these specifications shall be re-tested at no additional cost to the Owner.
10. 100% of the installed cabling must be tested and all tests must pass the acceptance criteria as defined herein.

11. All test reports shall include the following information for each cabling element tested:

    a. Wiremap results that indicate the cabling has no shorts, opens, miswires, split, reversed, or crossed pairs and end-to-end connectivity is achieved.
    b. Tests shall be performed in a swept frequency manner from 1 to 500 MHz. Information shall be provided for all pairs or pair combinations and in both directions. Any individual test that fails the relevant performance specifications shall be marked as FAIL.
    c. For Category 6A cabling, Insertion Loss, NEXT, PSNEXT, Return Loss, ACR-F Loss, PS-ACR-F Loss data that include the worst case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1MHz to highest relevant frequency, using a swept frequency interval that is in accordance with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
    d. Length, propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
    e. Cable manufacturer, cable model number/type, and Nominal Velocity of Propagation (NVP).
    f. Tester manufacturer, model, serial number, hardware version, and software version.
    g. Software shall be latest version.
    h. Circuit ID number and Project name.
    i. Autotest specification used.
    j. Overall PASS/FAIL indication.
    k. Date of test.
    l. Installer shall install and test all Category 6A permanent links per the installation requirements of the category 6A manufacturer. Installer shall provide a copy of these installation and testing requirements from the manufacturer with the hard copy test results.
    m. Installer shall follow TSB 190 in conjunction with the manufacturer's installation requirements.

G. All Category 3 Backbone Distribution cables Voice shall be tested for:

    1. Wiremap
    2. Length
    3. Loop Resistance

H. All fiber cables shall be tested after termination of both ends and tests shall be conducted in both directions. MCC to TR, TR to MCC,TER to MCC, MCC to Ter, MCR to MCCC, MCC to MCR. Each Multimode fiber shall be tested at the 850nm and 1300nm wavelengths, and each Singlemode cable shall be tested at the 1310nm and 1550nm wavelength for decibel loss utilizing a stabilized lightsource and optical power meter. Fiber testing must conform to ANSI/TIA/EIA 526, Optical Power Loss Measurements. The maximum loss of each strand shall not exceed 2.0dB. The Owner shall be supplied documentation with the following test results:

    1. End to end insertion loss testing for each fiber using Optical Power meter and light source.
    2. OTDR (Optical Time Domain Reflectometer) Signature traces of fiber runs in excess of 300 feet.
    3. Certificate of Compliance for Connector and Splice Loss.

4. The length of each fiber shall be measured using an Optical Time Domain Reflectometer (OTDR). A hard copy of the OTDR screen and the OTDR setting shall be provided to the Owner. Hand written test results will not be accepted.

I. Test reports shall be submitted within 7 business days of completion of testing.

J. Total System Acceptance Test: The Contractor shall perform verification tests for UTP copper cabling system(s) after the complete telecommunication distribution system and workstation outlet are installed.

1. Voice Testing: Connect to the network interface device at the demarcation point. Go off-hook and receive dial tone from the LEC. If a test number is available, place and receive a local, long distance, and FTS telephone call.
2. Data Testing: Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network is achieved.

3.4 TRAINING

A. Furnish the services of a factory-trained engineer or technician for a total of two four hour classes to instruct designated Facility IRM personnel. Instruction shall include cross connection, corrective, and preventive maintenance of the System and equipment.

B. Before the System can be accepted by the VA, this training must be accomplished. Training will be scheduled at the convenience of the Facilities Contracting Officer and Chief of Engineering Service.

3.5 GUARANTEE PERIOD OF SERVICE

A. Contractor’s Responsibilities:

1. The Contractor shall guarantee that all installed material and equipment will be free from defects, workmanship, and will remain so for a period of one year from date of final acceptance of the System by the VA. The Contractor shall provide OEM’s equipment warranty documents, to the RE (or Facility Contracting Officer if the Facility has taken procession of the building(s)), that certifies each item of equipment installed conforms to OEM published specifications.
2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. The Contractor and OEM shall provide this contact capability at no additional cost to the VA.
3. All Contractor installation, maintenance, and supervisor personnel shall be fully qualified by the OEM and must provide two (2) copies of current and qualified OEM training certificates and OEM certification upon request.
4. Additionally, the Contractor shall accomplish the following minimum requirements during the one year guarantee period:

    a. Response Time:

        1) The RE (or facility Contracting Officer if the facility has taken possession of the building[s]) are the Contractor’s reporting and contact officials for the System trouble calls, during the guarantee period.

2) A standard workweek is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal Holidays.
3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:

    a) A routine trouble call within one working days of its report. A routine trouble is considered a trouble which causes a system outlet, station, or patch cord to be inoperable.
    b) An emergency trouble call within 6 hours of its report. An emergency trouble is considered a trouble which causes a subsystem or distribution point to be inoperable at anytime. Additionally, the loss of a minimum of 50 station or system lines shall be deemed as this type of a trouble call.

4) The Contractor shall respond on-site to a catastrophic trouble_call within 4 hours of its report. A catastrophic trouble call is considered total system failure.

    a) If a system failure cannot be corrected within four hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate system CSS or TCO equipment, or cables. The alternate equipment and/or cables shall be operational within four hours after the four hour trouble shooting time.
    b) Routine or emergency trouble calls shall also be deemed as a catastrophic trouble call if so determined by the RE or Facility Director. The RE or Facility Contracting Officer shall notify the Contractor of this type of trouble call at the direction of the Facilities Director.

b. Required on-site visits during the one year guarantee period

1) The Contractor shall visit, on-site, for a minimum of eight hours, once every 12 weeks, during the guarantee period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the System according the descriptions identified in this SPEC.

    a) The Contractor shall arrange all Facility visits with the RE or Facility Contracting Officer prior to performing the required maintenance visits.
    b) The Contractor in accordance with the OEM's recommended practice and service intervals shall perform preventive maintenance during a non-busy time agreed to by the RE or Facility Contracting Officer and the Contractor.
    c) The preventive maintenance schedule, functions and reports shall be provided to and approved by the RE or Facility Contracting Officer.

2) The Contractor shall provide the RE or Facility Contracting Officer a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Contractor shall provide the RE with sample copies of these reports for review and approval at the beginning of the Total System Acceptance Test. The following reports are the minimum required:

    a) Monthly Report: The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this guarantee period to

RE or Facilities Contracting Officer by the fifth working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and Systems for preventive and predictive maintenance

b) Contractor Log: The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the System. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.

3) The RE or Facility Contracting Officer shall provide the Facility Engineering Officer, two (2) copies of actual reports for evaluation.

a) The RE or Facility Contracting Officer shall ensure copies of these reports are entered into the System's official acquisition documents.

b) The Facilities Chief Engineer shall ensure copies of these reports are entered into the System's official technical as-installed documents.

B. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use, accidents, other vendor, contractor, owner tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the RE or Facility Contracting Officer in writing upon the discovery of these incidents. The RE or Facility Contracting Officer will investigate all reported incidents and render findings concerning any Contractor's responsibility.

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SECTION 27 51 16
PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS

PART 1 - GENERAL

1.1 SECTION SUMMARY

A. Work covered by this document includes design, engineering, labor, material, products, guaranty, training and services for, and incidental to, the complete installation of a new and fully operating National Fire Protection Association (NFPA) Listed Emergency/Public Safety Public Address and Mass Notification communication (PA) system as detailed herein.

B. Work shall be complete, tested, labeled, certified and ready for operation

1.2 RELATED SECTIONS

A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 Volts and Below)

C. Section 26 41 00, FACILITY LIGHTNING PROTECTION

D. Section 27 05 26, GROUNDING AND BONDING FOR COMMUNCATIONS SYSTEMS

E. Section 27 05 11, REQUIREMENTS FOR COMMUNCATIONS INSTALLATIONS

F. Section 27 10 00, STRUCTURED CABLING

G. Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING

H. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS

1.3 DEFINITIONS

A. Provide: Design, engineer, furnish, install, connect complete, test, certify and guarantee.

B. Work: Materials furnished and completely installed.

C. Review of contract drawings: A service by the Engineer to reduce the possibility of materials being ordered which do not comply with contract documents. The engineer's review shall not relieve the Contractor of responsibility for dimensions or compliance with the contract documents. The reviewer's failure to detect an error does not constitute permission for the Contractor to proceed in error.

D. Headquarters Technical Review, for National and VA communications and security, codes, frequency licensing, standards, guidelines compliance:
Office of Telecommunications
Special Communications Team (005OP2B)
1335 East West Highway – 3rd Floor
Silver Spring, Maryland 20910
(O) 301-734-0350, (F) 301-734-0360

E. Engineer: Bard, Rao + Athanas Consulting Engineers, LLC

F. Owner: SLVHCS

G. General Contractor (GC):

H. Contractor: The successful bidder

1.4 REFERENCES

A. The installation shall comply fully with all governing authorities, laws and ordinances, regulations, codes and standards, including, but not limited to:

1. United States Federal Law/Codes:

a. Departments of:

1) CFR, Title 15 – Department of Commerce, Under the Information Technology Management Reform Act (Public Law 104-106), the Secretary of Commerce approves standards and guidelines that are developed by the:

a) Chapter II, National Institute of Standards Technology (NIST – formerly the National Bureau of Standards). Under Section 5131 of the Information Technology Management Reform Act of 1996 and the Federal Information Security Management Act of 2002 (Public Law 107-347), NIST develops – Federal Information Processing Standards Publication (FIPS) 140-2—Security Requirements for Cryptographic Modules.

b) Chapter XXIII, National Telecommunications and Information Administration (NTIA – aka 'Red Book') Chapter 7.8/9 Federal communications Commission (FCC) Title 47 (CFR), Part 15, Radio Frequency Restriction of Use and Compliance in "Safety of Life" Functions and Locations.

2) CFR, Title 29, Department of Labor, Chapter XVII - Occupational Safety and Health Administration (OSHA), Part 1910 – Occupational Safety and Health Standard:

   a) Subpart 7 - Definition and requirements for a National Recognized Testing Laboratory (NRTL – 15 Laboratory's, for complete list, contact http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html)

      (1) Underwriter's Laboratories (UL):

65	Standard for Wired Cabinets.
468	Standard for Grounding and Bonding Equipment.
1449	Standard for Transient Voltage Surge Suppressors.
1069	Hospital Signaling and Nurse Call Equipment.
60950-1/2	Information Technology Equipment – Safety.

      (2) Canadian Standards Association (CSA): same tests as for UL.
      (3) Communications Certifications Laboratory (CCL): same tests as for UL.
      (4) Intertek Testing Services NA, Inc. (ITSNA formerly Edison Testing Laboratory [ETL]): Same tests as for UL.

   b) Subpart 35, Compliance with NFPA 101, Life Safety Code.
   c) Subpart 36, Design and construction requirements for exit routes.
   d) Subpart 268, Telecommunications.
   e) Subpart 305, Wiring methods, components, and equipment for general use.

3) Title 42, CFC, Department of Health, Chapter IV Health and Human Services, Subpart 1395(a)(b) Joint Commission on Accreditation of Healthcare Organizations (JCAHO) "a hospital that meets JCAHO accreditation is deemed to meet the Medicare conditions of Participation by meeting Federal Directives:" All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.
4) All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.
5) CFR, Title 47 - Telecommunications, FCC: Part 15 – Restrictions of use for Part 15 listed Radio Equipment in Safety of Life/Emergency Functions/Equipment/Locations (also see CFR, Title 15 – Department of Commerce, Chapter XXIII – NTIA).
6) Public Law No. 100-527, Department of Veterans Affairs:

   a) Office of Telecommunications:

      (1) Handbook 6100, Telecommunications.

   b) Office of Cyber and Information Security (OCIS):

      (1) Handbook 6500, Information Security Program.
      (2) Wireless and Handheld Device Security Guideline Version 3.2, August 15, 2005.

   c) Spectrum Management FCC and NTIA Radio Frequency Compliance and Licensing Program.

2. National Codes:

a. American Institute of Architects (AIA): Guidelines for Healthcare Facilities.
b. American National Standards Institute/Electronic Industries Association and Telecommunications Industry Association (ANSI/EIA/TIA):

568-C.0	Commercial Building Telecommunications Wiring Standards:
569	Commercial Building Standard for Telecommunications Pathways and Spaces.
606	Administration Standard for the Telecommunications Infrastructure of Communications Buildings.
607	Commercial Building Grounding and Bonding Requirements for Telecommunications.
REC 127-49	Power Supplies.
RS 27	Tools, Crimping, Solderless Wiring Devices, Recommended Procedures for User Certification.

c. Institute of Electrical and Electronics Engineers (IEEE):

SO/TR 21730:2007	Use of mobile wireless communication and computing technology in healthcare facilities - Recommendations for electromagnetic compatibility (management of unintentional electromagnetic interference) with medical devices.
0739-5175/08/$25.00 ©2008IEEE	Medical Grade – Mission Critical – Wireless Networks.
C62.41	Surge Voltages in Low-Voltage AC Power Circuits.

d. NFPA:

70	National Electrical Code (current date of issue) – Articles 517, 645 and 800.
75	Standard for Protection of Electronic Computer Data- Processing Equipment.
77	Recommended Practice on Static Electricity.
101	Life Safety Code.

3. State Code(s).
4. Local Codes.

1.5 QUALIFICATIONS

A. The OEM shall have had experience with 3 or more installations of Public Address Systems of comparable size and complexity with regards to type and design as specified herein. Each of these installations shall have performed satisfactorily for at least 1 year after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the submittal.

B. The Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of 3 years. The Contractor shall be authorized by the OEM to pass thru the OEM's warranty of the installed equipment to VA. In addition, the OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the system. This documentation, along with the system Contractor and OEM certifications must be provided in writing as part of the Contractor's Technical submittal.

C. The Contractor's Communications Technicians assigned to the system shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the system. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the Resident Engineer before being allowed to commence work on the system.

D. Applicable national, state and local licenses.

E. Certificate of successful completion of OEM's installation/training school for installing technicians of the equipment being proposed.

1.6 CODES AND PERMITS

A. Provide all necessary permits and schedule all inspections as identified in the contract's milestone chart, so that the system is proof of performance tested and ready for operation on a date directed by the Owner.

B. The Contractor is responsible to adhere to all codes described herein and associated contractual, state and local codes.

1.7 SCHEDULING

A. After the award of contract, the Contractor shall prepare a detailed schedule (aka milestone chart) using "Microsoft Project" software or equivalent. The Contractor Project Schedule (CPS) shall indicate detailed activities for the projected life of the project. The CPS shall consist of detailed activities and their restraining relationships. It will also detail manpower usage throughout the project.

B. It is the responsibility of the Contractor to coordinate all work with the other trades for scheduling, rough-in, and finishing all work specified. The owner will not be liable for any additional costs due to missed dates or poor coordination of the supplying contractor with other trades.

1.8 REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS

A. Submit at one time within 10 days of contract awarding, drawings and product data on all proposed equipment and system. Check for compliance with contract documents and certify compliance with Contractor's "APPROVED" stamp and signature.

B. Support all submittals with descriptive materials, i.e., catalog sheets, product data sheets, diagrams, and charts published by the manufacturer. These materials shall show conformance to specification and drawing requirements.

C. Where multiple products are listed on a single cut-sheet, circle or highlight the one that you propose to use. Provide a complete and through equipment list of equipment expected to be installed in the system, with spares, as a part of the submittal. Special Communications (005OP3B – herein after referred to as 005OP3B) will not review any submittal that does not have this list.

D. Provide four copies to the PM for technical review. The PM will provide a copy to the offices identified in Paragraph 1.3.C and D, at a minimum for compliance review as described herein where each responsible individual(s) shall respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).

1.9 PROJECT RECORD DOCUMENTS (AS BUILTS)

A. Throughout progress of the work, maintain an accurate record of changes in Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.

B. The floor plans shall be marked in pen to include the following:

1. All device locations with labels.
2. Conduit locations.
3. Head-end equipment and specific location.
4. Wiring diagram.
5. Labeling and administration documentation.
6. Warranty certificate.
7. System test results.

1.10 WARRANTIES AND GUARANTY

A. The Contractor shall warrant the installation to be free from defect in material and workmanship for a period of 1 year from the date of acceptance of the project by the owner. The Contractor shall agree to remedy covered defects within eight (8) hours of notification of major failures or within twenty-four (24) hours of notification for individual station related problems.

B. Refer to Part 4 for applicable System Guarantee requirements.

1.11 USE OF THE SITE

A. Use of the site shall be at the GC's direction.

B. Coordinate with the GC for lay-down areas for product storage and administration areas.

C. Coordinate work with the GC and their sub-contractors.

D. Access to buildings wherein the work is performed shall be directed by the GC.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.

B. Store products in original containers.

C. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.

D. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the Owner.

1.13 PROJECT CLOSE-OUT

A. Prior to final inspection and acceptance of the work, remove all debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from the project site and thoroughly clean your work area.

B. Before the project closeout date, the Contractor shall submit:

1. Warranty certificate.
2. Evidence of compliance with requirements of governing authorities such as the Low Voltage Certificate of Inspection.
3. Project record documents.
4. Instruction manuals and software that is a part of the system.

C. Contractor shall submit written notice that:

1. Contract Documents have been reviewed.
2. Project has been inspected for compliance with contract.
3. Work has been completed in accordance with the contract

PART 2 – PRODUCTS AND FUNCTIONAL REQUIREMENTS

2.1 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

A. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Expansion Capability: Increase number of stations in the future by 50 percent above those indicated without adding any internal or external components or main trunk cable conductors.

C. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

D. Weather-Resistant Equipment: Listed and labeled by an OSHA certified National Recognized Testing Laboratory (NRTL – i.e. UL) for duty outdoors or in damp locations.

2.2 SYSTEM DESCRIPTION

A. System hardware shall consist of a public address communications network comprised of amplifiers, mixers, speakers, volume controls, test sets, telephone private branch exchange (PBX) interface equipment, equipment cabinets/racks, wiring and other options such as, sub zoning in addition to “all call” functions, computer interfaces, printer interfaces and wireless network interfaces, (when specifically approved by 005OP3B and VA Headquarters Spectrum Management 005OP2B – herein after referred to as 005OP2B) as shown on drawings. All necessary equipment required to meet the intent of these specifications, whether or not enumerated within these specifications, shall be supplied and installed to provide a complete and operating Overhead Paging and Public Address (PA) communications network.

B. Systems firmware shall be the product of a reputable firmware OEM of record with a proven history of product reliability and sole control over all source code. Manufacturer shall provide, free of charge, product firmware/software upgrades for a period of two year**s** from date of acceptance by VA for any product feature enhancements. System configuration programming changes shall not require any exchange of parts and shall be capable of being executed remotely via a modem connection (when specifically approved by 005OP3B).

C. The Public Address System (PAS) Head End Equipment shall be located in first floor TR Room. The PAS shall cover building areas and floor levels as depicted on the Contract Drawings. The PAS shall provide zoned, one-way voice paging through distributed, ceiling mounted loudspeakers. Voice input into the PAS shall be by zone using the telephone system. The PAS System is defined as an Emergency Communications Systems by NFPA

1. These functions shall be the minimum required of the PAS system:

   a. The Microphone Control Console locations shall be fully manned as long as the Facility is in operation.
   b. One global (aka “all call”) hard wired zone shall be provided that connects to every system speaker.
   c. There shall be 10 hard-wired sub-zones designated as follows:

      1) Police and Security Operations
      2) Engineering Services
      3) Administration Building
      4) Diagnostics and Treatment Building
      5) Inpatient Building
      6) Outpatient Building
      7) Transitional Living
      8) Research Building
      9) Central Energy Plant
      10) Concourse
      11) Each paging zone shall be capable of being programmed.
      12) The PAS shall have a minimum of 25, unused zones.

2. The PAS shall allow voice pages to be made within a single zone, across programmed multiple zones or a global page (all zones) by using preset codes entered into the keypad of any telephone attached to the PBX or VoIP gateway.

D. The PAS shall interface with any existing paging system so that a global page (aka “all call” page) is communicated to the existing paging system and the new PAS of this project. Arrangements for interconnection of the PAS and the telephone system(s) shall be coordinated with the owner and the PBX provider.

E. Each PAS system shall be designed to provide continuous electrical supervision of the complete and entire system (i.e. light bulbs, wires, contact switch connections, master control stations, wall stations, circuit boards, data, audio, and communication busses, main and UPS power, etc.). All alarm initiating and signaling circuits shall be supervised for open circuits, short circuits, and system grounds. Main and UPS power circuits shall be supervised for a change in state (i.e. primary to backup, low battery, UPS on line, etc.). When an open, short or ground occurs in any system circuit, an audible and visual fault alarm signal shall be initiated at the nurse control station and all remote locations.

F. When the PAS system is approved to connect to a separate communications system (i.e. LAN, WAN, Telephone, etc) the connection point shall meet the following minimum requirements for each hard wired connection and shall be pre-approved by the VA OIT group (note each wireless system connection must also be approved prior to contract bid by VA Headquarters Spectrum Management 005OP3B and 005OP2B):

1. UL 60950-1/2.
2. FIPS 142.
3. FCC Part 15 Listed Radio Equipment is not allowed.

G. Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating system. Unless otherwise noted in this Part, equipment quantities shall be as indicated on the drawings.

2.3 MANUFACTURERS

A. The products specified shall be new, UL Listed, and produced by OEM manufacturer of record.

B. The following equipment items are the salient requirements of VA to provide an acceptable system described herein.

2.4 TELEPHONE INTERFACE EQUIPMENT

A. Paging Adaptor:

1. The Contractor shall coordinate the installation of the paging adapter(s) designed for use with the Facility's telephone system with the Facility Telephone Contractor or local telephone company.
2. The Contractor shall provide and install a paging adapter(s) for each zone and sub zone. The paging adapter(s) shall be accessible by dialing a telephone number provided by the Facility's Telephone Contractor. The Paging Adapter shall:

    a. Monitor each audio input and output on the unit.
    b. Be provided with an electrical supervision panel to provide both audio and visual trouble alarms.
    c. Be provided as part of the Head End equipment and shall be located in the Telephone Switch Room.
    d. Be capable of internal time out capability.
    e. Function completely with the interface module.

B. Time Out Device:

1. A time out device/capability shall be provided to prevent system "hang-up" due to an off-hook telephone. The device shall be able to be preset from 30 seconds to 2 minutes. Its function shall not interfere with or override the required "all call" (aka global) operational capability.
2. Audio Monitor Panel:

    a. The panel shall be EIA/TIA standard for 483 mm (19") cabinet mounting.
    b. It shall be provided in the upper portion of the head-end equipment cabinet

C. Interface Module:

1. Universal telephone port interface with input for background music.
2. Gain control for telephone and background music inputs.
3. Emergency page override.

D. Central Processor Module:

1. Controls system operations and holds all programmed parameters.
2. Data link connection to additional CPU modules.

E. Zone Module:

1. Provides paging zone outputs at 70V.
2. Background Music inhibit switch for each zone.

F. Power Module: Provides 12V DC @ 800mA to Central Processor Module.

G. Rack mounting: Provide rack mount kit.

2.5 HEAD-END EQUIPMENT

A. Provide all required power supplies, communications hubs, network switches, intelligent controllers and other devices necessary to form a complete system listed in Paragraph 2.3. Head-end components may be rack mounted or wall mounted in a metal enclosure.

B. Provide the head end equipment in the closed telecommunications closet where the PAS system is installed to include the minimum equipment listed in Paragraph 2.3.

C. Provide minimum of 1-hour battery back-up to paging system components such that the system functions are maintained upon building power loss for this period .

D. P.A. head end equipment shall be wall mounted.

2.6 AMPLIFIER EQUIPMENT

A. Paging:

1. Inputs for 600-ohm balanced telephone line, LO-Z balanced microphone, and background music.
2. Input Sensitivity: Compatible with master stations and central equipment so amplifier delivers full rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on master stations, speaker microphones, or handset transmitters
3. Automatic Level Control (ALC) for pages, adjustable background music muting level during, page, wall or rack mountable.
4. 16-ohm, 25V, 25V center tapped (CT), and 70V outputs. Amplifier quantity and size (output power) as needed. Continuous amplifier power rating shall exceed loudspeaker load on amplifier by at least 25 percent.
5. Output Power: 70-V balanced line. 80 percent of the sum of wattage settings of connected for each station and speaker connected in all-call mode of operation, plus an allowance for future stations.

6. Total Harmonic Distortion: Less than 5 percent at rated output power with load equivalent to quantity of stations connected in all-call mode of operation.
7. Minimum Signal-to-Noise Ratio: 45 dB, at rated output.
8. Frequency Response: Within plus or minus 3 dB from 70 to 12,000 Hz.
9. Output Regulation: Maintains output level within 2 dB from full to no load.
10. Amplifier Protection: Prevents damage from shorted or open output.
11. Be provided with electronic supervision function(s).
12. Provide one spare amplifier.

B. Distributed:

1. Refer to the Head End Amplifier characteristics in paragraph 2.4.A. for each amplifier used in the distribution system.
2. Provide one spare amplifier in addition to the spare Head End amplifier.

2.7 SYSTEM SPEAKERS

A. Ceiling Cone-Type:

1. Minimum Axial Sensitivity: 91 dB at one meter, with 1-W input.
2. Frequency Response: Within plus or minus 3 dB from 70 to 15,000 Hz.
3. Minimum Dispersion Angle: 100 degrees.
4. Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.
5. Enclosures: Steel housings or back boxes, acoustically dampened, with front face of at least 0.0478-inch steel and whole assembly rust proofed and factory primed; complete with mounting assembly and suitable for surface ceiling, flush ceiling, pendant or wall mounting; with relief of back pressure.
6. Baffle: For flush speakers, minimum thickness of 0.032-inch aluminum with textured white finish. Completely fill the baffle with fiberglass.
7. Vandal-Proof, High-Strength Baffle: For flush-mounted speakers, self-aging cast aluminum with tensile strength of 44,000 psi, 0.025-inch minimum thickness; countersunk heat-treated alloy mounting screws; and textured white epoxy finish.
8. Size: 4 inches with 1-inch voice coil and minimum 5-oz. ceramic magnet.
9. Have a minimum of 2 safety wires installed to a solid surface or use a flexible conduit from ceiling/wall back box to the speaker back box.
10. The speakers and mounting shall be self contained and wall mounted with flush back box at a minimum of 10 meter intervals and shall match (or contrast with, at the direction of the Resident Engineer) the color of the adjacent surfaces.
11. Provide one spare speaker, mount, and back box for each 50 speakers or portion thereof.
12. Integral volume control button.

B. Wall Mounted Horn-Type:

1. Each horn speaker shall be provided with a means of adjusting the output level over the rated horn speaker range to an appropriate audio level in the area installed.
2. Provide horn speakers in equipment rooms, mechanical room, supply warehouse areas, loading dock, entrance and exit areas, and at other areas as indicated on the drawings.
3. Speakers shall be all-metal, weatherproof construction; complete with universal mounting brackets.
4. Frequency Response: Within plus or minus 3 dB from 275 to 14,000 Hz.
5. Minimum Power Rating of Driver: 15 W, continuous.
6. Minimum Dispersion Angle: 110 degrees.

7. Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.
8. Provide one spare speaker, mount, and back box for each 20 speakers or portion thereof.
9. Integral volume control button.

2.8 SYSTEM CABLES

A. Refer to OFM approved Construction Specification 27 10 00, STRUCTURED CABLING for specific installation and testing requirements.

B. Line Level Audio and Microphone Cable:
1. Line level audio and microphone cable for inside racks and conduit.
2. Shielded, twisted pair Minimum #22 AWG, stranded conductors and 24AWG drain wire with overall jacket.

C. Speaker Level Audio Cable (70v):

1. For use with 70-volt speaker circuits.
2. #18 AWG stranded pair, minimum.

D. Speaker Level Audio Cable, Plenum Rated (70v):

1. For use with 70-volt speaker circuits.
2. #18 AWG stranded pair, minimum.

E. All cabling shall be NEC plenum rated.

F. Provide 1 spare 1,000 foot roll of approved system (not microphone) cable.

2.9 RACEWAYS

A. Intercommunication and Program System Raceways and Boxes: Comply with requirements in Division 27 Section 27 05 33 "Raceway and Boxes for Communications Systems."

B. Each raceway that is open top, shall be: UL certified for telecommunications systems, partitioned with metal partitions in order to comply with NEC Parts 517 and 800 to “mechanically separate telecommunications systems of different service, protect the installed cables from falling out when vertically mounted and allow junction boxes to be attached to the side to interface “drop” type conduit cable feeds.

C. Intercommunication System cable infrastructure: EMT or in J-hooks above accessible ceilings, 24 inches on center.

D. Junction boxes shall be not less than 2-1/2 inches deep and 6 inches wide by 6 inches long.

E. Flexible metal conduit is prohibited unless specifically approved by 005OP3B.

2.10 CONDUIT SLEEVES

A. The Engineer has made a good effort to identify where conduit sleeves through full-height and fire rated walls on the drawings, and has instructed the electrician to provide the sleeves as shown on the drawings.

B. While the sleeves shown on the drawings will be provided by others, the contractor is responsible for installing conduit sleeves and fireproofing where necessary. It is often the case, that due to field conditions, the nurse-call cable may have to be installed through an alternate route. Any conduit sleeves required due to field conditions or those omitted by the Engineer shall be provided by the Cabling Contractor.

2.11 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Provide a backup battery or a UPS for the system to allow normal operation and function (as if there was no AC power failure) in the event of an AC power failure or during input power fluctuations for a minimum of 1-hour.

B. As an alternate solution, the telephone system UPS may be utilized to meet this requirement at the Head End location, as long as this function is specifically approved by the Telephone Contractor and the Resident Engineer.

C. The PA Contractor shall not make any attachments or connection to the telephone system until specifically directed to do so, in writing, by the Resident Engineer.

D. Provide UPS for all active system components including but not limited to:

1. System Amplifiers.
2. Microphone Consoles.
3. Telephone Interface Units.
4. PBX and Head End Equipment Rack(s.

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

A. Assign a single project manager to this project who will serve as the point of contact for the Owner, the General Contractor, and the Engineer.

B. The Contractor shall be proactive in scheduling work at the hospital, specifically the Contractor will initiate and maintain discussion with the general contractor regarding the schedule for ceiling cover up and install cables to meet that schedule.

C. Contact the Office of Telecommunications, Special Communications Team (005OP3B) at (301) 734-0350 to have a VA Certified Telecommunications COTR assigned to the project for telecommunications review, equipment and system approval and co-ordination with VA's Spectrum Management and OCIS Teams.

3.2 COORDINATION WITH OTHER TRADES

A. Coordinate with the cabling contractor the location of optical fiber backbone pairs and equipment rack mounting within the Low Voltage Systems LVSys Rooms.

B. Before beginning work, verify the location, quantity, size and access for the following:

1. Isolated ground AC power circuits provided for systems.
2. Primary, emergency and extra auxiliary AC power generator requirements.

3. Junction boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for the systems.
4. System components installed by others.
5. Overhead supports and rigging hardware installed by others.

C. Immediately notify the Owner, General Contractor and Consultant in writing of any discrepancies.

3.3 INSTALLATION

A. General:

1. Execute work in accordance with National, State and local codes, regulations and ordinances.
2. Install work neatly, plumb and square and in a manner consistent with standard industry practice. Carefully protect work from dust, paint and moisture as dictated by site conditions. The Contractor will be fully responsible for protection of his work during the construction phase up until final acceptance by the Owner.
3. Install equipment according to OEM's recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
4. Secure equipment firmly in place, including receptacles, speakers, equipment racks, system cables, etc:

    a. All supports, mounts, fasteners, attachments and attachment points shall support their loads with a safety factor of at least 5:1.
    b. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems.
    c. Any suspended equipment or associated hardware must be certified by the OEM for overhead suspension.
    d. The Contractor is responsible for means and methods in the design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.

5. Locate overhead ceiling-mounted loudspeakers as shown on drawings, with minor changes not to exceed 12" in any direction:

    a. Mount transformers securely to speaker brackets or enclosures using screws. Adjust torsion springs as needed to securely support speaker assembly.
    b. Speaker back boxes shall be completely filled with fiberglass insulation.
    c. Seal cone speakers to their enclosures to prevent air passing from one side of the speaker to the other.

6. Finishes for any exposed work such as plates, racks, panels, speakers, etc. shall be approved by the Architect, Owner and 005OP3B.
7. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and surrounding wall. Where cover plates are not fitted with connectors, provide grommeted holes in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.

B. Equipment Racks:

1. Fill unused equipment mounting spaces with blank panels or vent panels. Match color to equipment racks.
2. Provide security covers for all devices not requiring routine operator control.

3. Provide vent panels and cooling fans as required for the operation of equipment within the OEM' specified temperature limits. Provide adequate ventilation space between equipment for cooling. Follow manufacturer's recommendations regarding ventilation space between amplifiers.
4. Provide insulated connections of the electrical raceway to equipment racks.
5. Provide continuous raceway/conduit with no more than 40 percent fill between wire troughs and equipment racks for all non-plenum-rated cable. Ensure each system is mechanically separated from each other in the wireway.

C. Wiring Practice: In addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 10 00, STRUCTURED CABLING, the following additional practices shall be adhered to:

1. Comply with requirements for raceways and boxes specified in Division 27 Section 27 05 33 "Raceway and Boxes for Communications Systems."
2. Execute all wiring in strict adherence to the National Electrical Code, applicable local building codes and standard industry practices.
3. Wiring shall be classified according to the following low voltage signal types:

    a. Balanced microphone level audio (below -20dBm) or Balanced line level audio (-20dBm to +30dBm)
    b. 70V loudspeaker level audio.
    c. Low voltage DC control or power (less than 48VDC)

4. Where raceway is to be EMT (conduit), wiring of differing classifications shall be run in separate conduit. Where raceway is to be an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications which share the same enclosure shall be mechanically partitioned and separated by at least four inches. Where Wiring of differing classifications must cross, they shall cross perpendicular to one another.
5. Do not splice wiring anywhere along the entire length of the run. Make sure cables are fully insulated and shielded from each other and from the raceway for the entire length of the run.
6. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.
7. Replace the entire length of the run of any wire or cable that is damaged or abraided during installation. There are no acceptable methods of repairing damaged or abraided wiring.
8. Use wire pulling lubricants and pulling tensions as recommended by the OEM.
9. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
10. Do not use tape-based or glue-based cable anchors.
11. Ground shields and drain wires as indicated by the drawings.
12. Field wiring entering equipment racks shall be terminated as follows:

    a. Provide ample service loops at harness break-outs and at plates, panels and equipment. Loops should be sufficient to allow plates, panels and equipment to be removed for service and inspection.
    b. Line level and speaker level wiring may be terminated inside the equipment rack using specified terminal blocks (see "Products"). Provide 15percent spare terminals inside each rack. Microphone level wiring may only be terminated at the equipment served.
    c. If specified terminal blocks are not designed for rack mounting, utilize 3/4" plywood or 1/8" thick aluminum plates/blank panels as a mounting surface. Do not mount on the bottom of the rack.
    d. Employ permanent strain relief for any cable with an outside diameter of 1" or greater.

13. Use only balanced audio circuits unless noted otherwise
14. Make all connections as follows:

    a. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.
    b. For crimp-type connections, use only tools that are specified by the manufacturer for the application.
    c. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.
    d. Wire nuts, electrical tape or “Scotch Lock” connections are not acceptable for any application.

D. Cable Installation: In addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 10 00, STRUCTURED CABLING, the following additional practices shall be adhered to:

1. Support cable on maximum 4’-0” centers. Acceptable means of cable support are cable tray, j-hooks, and bridal rings. Velcro wrap cable bundles loosely to the means of support with plenum rated Velcro straps. Plastic tie wraps are not acceptable as a means to bundle cables.
2. Run cables parallel to walls.
3. Install maximum of 10 cables in a single row of J-hooks. Provide necessary rows of J-hooks as required by the number of cables.
4. Do not lay cables on top of light fixtures, ceiling tiles, mechanical equipment, or ductwork. Maintain at least 2’-0” clearance from all shielded electrical apparatus.
5. All cables shall be tested after the total installation is fully complete. All test results are to be documented. All cables shall pass acceptable test requirements and levels. Contractor shall remedy any cabling problems or defects in order to pass or comply with testing. This includes the re-pull of new cable as required at no additional cost to the Owner.
6. Ends of cables shall be properly terminated on both ends per industry and OEM’s recommendations.
7. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off of the floor until you are ready to terminate.
8. Cover the end of the overall jacket with a 1” (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2” (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2” (minimum) past the Heat-shrink and serve as indicated below.
9. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing ¼” past the end of unused wires, fold back over jacket and secure with cable tie.
10. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.
11. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
12. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
13. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
14. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.
15. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.

16. Separation of Wires: (REFER TO RACEWAY INSTALLATION) Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
17. Serve all cables as follows:

    a. Cover the end of the overall jacket with a 1" (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2" (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield and drain wires 2" (minimum) past the Heat-shrink and serve as indicated below.
    b. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing ¼" past the end of unused wires, fold back over jacket and secure with cable tie.
    c. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.

E. Labeling:

1. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
2. Engrave and paint fill all receptacle panels using 1/8" (minimum) high lettering and contrasting paint.
3. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8" (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment.
4. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.
5. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively, computer generated labels of the type which include a clear protective wrap may be used.
6. Contractor's name shall appear no more than once on each continuous set of racks. The Contractor's name shall not appear on wall plates or portable equipment.
7. Ensure each OEM supplied equipment has appropriate UL Labels/Marks for the service the equipment is performed permanently attached/marked. Equipment installed not bearing these UL marks will not be allowed to be part of the system. The Contractor shall bear all costs required to provide replacement equipment with approved UL marks.

3.4 PROTECTION OF NETWORK DEVICES

A. Contractor shall protect network devices during unpacking and installation by wearing manufacturer approved electrostatic discharge (ESD) wrist straps tied to chassis ground. The wrist strap shall meet OSHA requirements for prevention of electrical shock, should technician come in contact with high voltage.

3.5 CLEANING AND PATCHING

A. It shall be the responsibility of the contractor to keep their work area clear of debris and clean area daily at completion of work.

B. It shall be the responsibility of the contractor to patch and paint any wall or surface that has been disturbed by the execution of this work.

C. The Contractor shall be responsible for providing any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete the work or to make its parts fit together properly.

D. The Contractor shall not damage or endanger a portion of the work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate Contractor, the Contractor's consent to cutting or otherwise altering the work.

E. Where coring of existing (previously installed) concrete is specified or required, including coring indicated under unit prices, the location of such coring shall be clearly identified in the field and the location shall be approved by the Project Manager prior to commencement of coring work.

3.6 FIREPROOFING

A. Where PAS cables penetrate fire rated walls, floors and ceilings, fireproof the opening.

B. Provide conduit sleeves (if not already provided by Electrical Contractor) for cables that penetrate fire rated walls. After the cabling installation is complete, install fire proofing material in and around all conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal all floor and ceiling penetrations.

C. Use only materials and methods that preserve the integrity of the fire stopping system and its rating.

3.7 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.

C. Install grounding electrodes as specified in Division 27, Section 27 05 26 "Grounding and Bonding for Communications Installations" and coordinate the connection to building electrical ground with Division 26, Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

D. Do not use "3rd or 4th" wire internal electrical system conductors for ground.

E. Do not connect system ground to the building's external lightning protection system.

F. Do not "mix grounds" of different systems.

PART 4 - TESTING/GUARANTY/TRAINING

4.1 SYSTEM CLASSIFICATION

A. The PAS System is NFPA listed as an “Emergency and Public Safety” Communications system. Where Code Blue signals are transmitted, that listing is elevated to “Life Support.” Therefore, the following testing and guaranty provisions are the minimum to be performed and provided by the contractor and OEM.

4.2 PROOF OF PERFORMANCE TESTING

A. Intermediate Testing:

1. After completion of 25 – 30 percent the installation of a head end cabinet(s) and equipment, one microphone console, local and remote enunciation stations, 2 zones, 2 sub zones prior to any further work, this portion of the system must be pre-tested, inspected, and certified. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed, NFPA, Life Safety, and JCAHCO guidelines are followed, and proper installation practices are followed. The intermediate test shall include a full operational test.
2. The inspection and test will be conducted by a factory-certified representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by the Government Representative and maintained on file by the Resident Engineer (RE), until completion of the entire project. The results will be compared to the Acceptance Test results. An identical inspection may be conducted between the 65 - 75 percent of the system construction phase, at the direction of the Resident Engineer.

B. Pretesting:

1. Upon completing installation of the PAS System, the Contractor shall align, balance, and completely pretest the entire system under full operating conditions.
2. Pretesting Procedure:

a. During the system pretest the Contractor shall verify (utilizing approved test equipment) that the system is fully operational and meets all the system performance requirements of this standard.
b. The Contractor shall pretest and verify that all system functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc., are present. At a minimum, each of the following locations shall be fully pre-tested:

1) Central Control Cabinets.
2) PA Control Stations.
3) Zone Equipment/Systems.
4) Sub-Zone Equipment/Systems.
5) Local and Remote Enunciation Panels.
6) All Networked locations.
7) System interface locations (i.e. TELCO, two way radio, etc.).
8) System trouble reporting.
9) System Electrical Supervision.
10) UPS operation.

3. The Contractor shall provide four copies of the recorded system pretest measurements and the written certification that the system is ready for the formal acceptance test shall be submitted to the Resident Engineer.

C. Acceptance Test:

1. After the system has been pre-tested and the Contractor has submitted the pretest results and certification to the Resident Engineer, then the Contractor shall schedule an acceptance test date and give the Resident Engineer 30 days written notice prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a Government Representative and an OEM certified representative. The system shall be tested utilizing the approved test equipment to certify proof of performance and Emergency and Public Safety compliance. The test shall verify that the total system meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
2. The acceptance test shall be performed on a "go-no-go" basis. Only those operator adjustments required to show proof of performance shall be allowed. The test shall demonstrate and verify that the installed system does comply with all requirements of this specification under operating conditions. The system shall be rated as either acceptable or unacceptable at the conclusion of the test. Failure of any part of the system that precludes completion of system testing, and which cannot be repaired in 4 hours, shall be cause for terminating the acceptance test of the system. Repeated failures that result in a cumulative time of 8 hours to affect repairs shall cause the entire system to be declared unacceptable. Retesting of the entire system shall be rescheduled at the convenience of the Government.

D. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:

a. The VACO Government Representative will tour all major areas where the system is and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.
b. The system diagrams, record drawings, equipment manuals, Telecommunications Infrastructure Plant (TIP) Auto CAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.
c. Failure of the system to meet the installation requirements of this specification shall be grounds for terminating all testing.

2. Operational Test:

a. After the Physical and Mechanical Inspection, the central terminating and nurse call master control equipment shall be checked to verify that it meets all performance requirements outlined herein. A spectrum analyzer and sound level meter may be utilized to accomplish this requirement.
b. Additionally, each installed head end equipment, microphone console, amplifier, mixer, distributed speaker/amplifier, monitor speaker, telephone interface, power supply and remote amplifiers shall be checked insuring they meet the requirements of this specification.
c. Once these tests have been completed, each installed sub-system function shall be tested as a unified, functioning and fully operating system. The typical functions are: “all call,” three sub-zoned, minimum of 10 minutes of UPS operation, electrical supervision, trouble panel, corridor speakers and audio paging.

d. Individual Item Test: The Government Representative will select individual items of equipment for detailed proof of performance testing until 100 percent of the system has been tested and found to meet the contents of this specification. Each item shall meet or exceed the minimum requirements of this document.

3. Test Conclusion:

a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the Resident Engineer. Any retesting to comply with these specifications will be done at the Contractor's expense.
b. If the system is declared unacceptable without conditions, all rescheduled testing expenses will be born by the Contractor.

E. Acceptable Test Equipment

1. The test equipment shall furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:

a. Spectrum Analyzer.
b. Signal Level Meter.
c. Volt-Ohm Meter.
d. Sound Pressure Level (SPL) Meter.
e. Oscilloscope.
f. Random Noise Generator.
g. Audio Amplifier with External Speaker.

4.3 SYSTEM GUARANTEE PERIOD OF SERVICE

A. Contractor’s Responsibility:

1. The Contractor shall guarantee that all provided material and equipment will be free from defects, workmanship and will remain so for a period of one year from date of final acceptance of the system by the VA. The Contractor shall provide OEM’s equipment warranty documents, to the Resident Engineer (or Facility Contracting Officer if the Facility has taken procession of the building), that certifies each item of equipment installed conforms to OEM published specifications.
2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. This contact capability shall be provided by the Contractor and OEM at no additional cost to the VA.
3. All Contractor maintenance and supervisor personnel shall be fully qualified by the OEM and must provide 2 copies of current and qualified OEM training certificates and OEM certification upon request.

4. Additionally, the Contractor shall accomplish the following minimum requirements during the two year guarantee period:

   a. Response Time during the Two Year Guarantee Period:

      1) The Resident Engineer (or Facility Contracting Officer if the system has been turned over to the Facility) is the Contractor's only official reporting and contact official for PAS system trouble calls, during the guarantee period.
      2) A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by the Resident Engineer (or Facility Contracting Officer), Monday through Friday exclusive of Federal Holidays.
      3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:

         a) A routine trouble call within 1 working day of its report. A routine trouble is considered a trouble which causes a pillow speaker or cordset, 1 master IC control station, room station or emergency station to be inoperable.
         b) Routine trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) shall also be deemed as an emergency trouble call. The Resident Engineer (or Facility Contracting Officer) shall notify the Contractor of this type of trouble call.
         c) An emergency trouble call within 4 hours of its report. An emergency trouble is considered a trouble which causes a sub-system (ward), distribution point, terminal cabinet, or all call system to be inoperable at anytime.

      4) If a PAS component failure cannot be corrected within four hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate nurse call equipment. The alternate equipment/system shall be operational within a maximum of 20 hours after the four hour trouble shooting time and restore the effected location operation to meet the system performance standards. If any sub-system or major system trouble cannot be corrected within one working day, the Contractor shall furnish and install compatible substitute equipment returning the system or sub-system to full operational capability, as described herein, until repairs are complete.

   b. Required On-Site Visits during the Two Year Guaranty Period

      1) The Contractor shall visit, on-site, as necessary, during the guarantee period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the system according the descriptions identified in this document.
      2) The Contractor shall arrange all Facility visits with the Resident Engineer (or Facility Contracting Officer) prior to performing the required maintenance visits.
      3) Preventive maintenance shall be performed by the Contractor in accordance with the OEM's recommended practice and service intervals during non-busy time agreed to by the Resident Engineer (or Facility Contracting Officer) and Contractor.
      4) The preventive maintenance schedule, functions and reports shall be provided to and approved by the Resident Engineer (or Facility Contracting Officer).

5) The Contractor shall provide the Resident Engineer (or Facility Contracting Officer) a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Contractor shall provide the Resident Engineer with sample copies of these reports for review and approval at the beginning of the Acceptance Test. The following reports are the minimum required:

   a) The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this guarantee period to Resident Engineer (or Facility Contracting Officer) by the fifth (5th) working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and systems for preventive and predictive maintenance.
   b) The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the system. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.

6) The Resident Engineer (or Facility Contracting Officer) shall convey to the Facility Engineering Officer, 2 copies of actual reports for evaluation.

   a) The Resident Engineer (or Facility Contracting Officer) shall ensure a copy of these reports is entered into the system's official acquisition documents.
   b) The Facility Chief Engineer shall ensure a copy of these reports is entered into the system's official technical record documents.

B. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use; accidents; other vendor, contractor, or owner tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the Resident Engineer or Facility Contracting Officer in writing upon the discovery of these incidents. The Resident Engineer or Facility Contracting Officer will investigate all reported incidents and render

4.4 TRAINING

A. Provide thorough training of the owner's engineering and maintenance staff.

B. Provide the following minimum training times and durations:

1. 48 hours prior to opening
2. 24 hours during the opening week
3. 24 hours follow up review for supervisors and system administrators

- - - E N D - - -

SECTION 27 53 19
IN BUILDING WIRELESS SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes technical and performance requirements for an In-building Wireless System (IWS) based upon active amplification and Distributed Antenna System (DAS) architecture to support neutral Wireless Service Providers (WSP) and Public Safety Radio Enhancement / Emergency Responder (“Public Safety”, “First Responder”) Radio Coverage.

B. The In-building Wireless System Contractor shall provide all system design, project management, coordination with Wireless Service Providers, coordination with Public Safety Radio Enhancement / Emergency Responder services, coordination with Owner Entities (e.g. Police, Facilities, IT/IS/IRMS, Telecommunications Voice Engineering and Spectrum Management) hardware, equipment, antennae, cabling, labeling, testing, configuration, programming, coordination and documentation for a complete and operable system.

C. The In-building Wireless System Contractor shall coordinate required permits, submittals and approvals of the AHJ.

D. Sustainable Design Requirements: Provide the Work and submit documentation necessary for compliance with sustainable requirements specified in Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS**.**

1.2 RELATED WORK

A. Mounting board for communication closets: Section 06 10 00, ROUGH CARPENTRY.

B. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.

C. Fabrications for the deflection of water away from the building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.

D. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: Section 07 92 00, JOINT SEALANTS.

E. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.

F. General electrical requirements and items that is common to more than one section of Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

G. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

H. 27 05 33 RACEWAYS AND BOXES FOR COMMUNICATIONS

1.3 RELATED DOCUMENTS

A. Project Contract Documents

B. AHJ Ordinance and/or Supplemental Rules and Regulations for Public Safety Radio Enhancement / Emergency Responder Amplification Systems.

C. This Section may expand upon or supplement the AHJ requirements for Public Safety Radio Amplification Systems. In the event of a conflict or discrepancy between this Section and the requirements for Public Safety Radio Amplification Systems, the requirements for Public Safety Radio Amplification Systems shall govern. However, if the requirement of this Section (or portion thereof) exceeds that of the requirements for Public Safety Radio Amplification Systems, and is furthermore not contrary to the requirements for Public Safety Radio Amplification Systems, then the Contractor shall identify what part of section has been exceeded and receive approval from Engineer and VA for acceptance.

1.4 DEFINITIONS

A. In addition to the definitions of Division 27, the following list of terms are defined as follows:

1. AWS – Advanced Wireless Services (synonymous with AWS-1 and UMTS band IV)
2. BDA – Bi-Directional Amplifier
3. BTS – Base Transceiver Station
4. DAS – Distributed Antenna System
5. HSPA – High Speed Packet Access
6. iDEN – Integrated Digital Enhanced Network
7. ISM – Industrial, Scientific, Medical
8. IWS – In-building Wireless System
9. LBS – Location Based Services
10. LMR – Land Mobile Radio
11. LTE – Long Term Evolution
12. OET – Office of Engineering and Technology
13. PCS – Personal Communications Service
14. RAN – Radio Access Network
15. RF – Radio Frequency
16. RFID – Radio Frequency Identification
17. RSSI – Received Signal Strength Indication
18. RTLS – Real Time Location Services/System
19. SMR – Specialized Mobile Radio
20. UMTS – Universal Mobile Telecommunications System
21. VOIP – Voice Over Internet Protocol
22. WiFi – Wireless Fidelity
23. WiMAX – Worldwide Interoperability for Microwave Access
24. WMTS – Wireless Medical Telemetry Service
25. WSP – Wireless Service Provider

1.5 SYSTEM DESCRIPTION

A. Overview

1. The in-building wireless system, herein referred to as “System” shall be a distributed antenna system. The System shall reliably distribute RF signals and wireless services throughout the specified frequency ranges and throughout the specified coverage spaces.
2. The System shall be implemented based on proven state-of-the-art technology that can seamlessly integrate with the rapid evolution of wireless technologies and business applications.
3. The System shall include a head-end subsystem. The head-end shall include a wideband transceiver and be a common interface node. The head end shall be co-located with Base Station systems from multiple cellular common carriers, with the wireless paging system, and with the two-way radio system.
4. The IWS shall have all active elements (remote units) in secure telecom rooms to simplify maintenance and increase security. Locating active elements in or above ceilings is not acceptable. Locations for active equipment shall be approved by the Engineer.
5. Radiating coax or “leaky” coax systems are not acceptable.
6. Coverage antennas are to be located minimum of one for every twenty-five thousand square feet and shall provide signal strength as defined in this Specification.

B. Design Criteria

1. System shall meet the requirements of the AHJ for Public Safety Radio Amplification Systems.
2. Active signal handling: The IWS shall have active elements that filter and amplify signals on a frequency specific basis to consistently deliver wireless services at the appropriate power levels.
3. Frequency Range: The System shall support all frequencies between 400 MHz to 2500 MHz.
4. The System shall distribute RF coverage at levels outlined below in the following areas of the building(s) – herein specified coverage areas:

    a. Floor areas including corridors, lobbies, Concourse and Interstial spaces.
    b. Penthouses
    c. Bridges/Building links
    d. Stairwells
    e. Elevator lobbies
    f. General Use spaces (break rooms, staff rooms)
    g. Restrooms
    h. Exterior public spaces (e.g. courtyards)
    i. Excluded Areas:

        1) No areas are excluded

5. The System shall be able to simultaneously support the following wireless services, applications, and/or technologies:

    a. The System shall distribute cellular channels with signal strength at least +8 dBm greater than the signal outside of the building and at least -85 dBm “wall to wall” inside the building.
    b. The System shall meet the wireless carrier’s requirements.

c. Facility's Systems

1) Local (Pocket Pager) Wireless Pagers. Coordinate frequency with VA.

d. Wireless Operators: Nextel/Sprint, Verizon, AT&T, TMobile MetroPCS:

1) VHF (150 MHz)
2) LTE (700 MHz) – Verizon, AT&T (4G) (MIMO 2x2)
3) Cellular (850 MHz) - AT&T, Verizon (2.5G & 3G)
4) PCS (1900MHz) - Verizon, Sprint (2.5G & 3G)
5) iDEN (800/900MHz) – Nextel/Sprint
6) AWS (1700/2100 MHz) - AT&T, T-Mobile, MetroPCS (3G /4G LTE)
7) Base stations (base units) shall be provided by the particular wireless operator.

e. Public Safety Radio Enhancement / Emergency Responder

1) The System shall distribute Public Safety channels with a signal strength that exceeds the minimum requirements specified by the AHJ. Public Safety includes VA Police services, local and city police, county sheriff, emergency medical services, and fire departments.
2) 95 percent coverage of all areas of each building level
3) UHF (450 - 520 MHz)
4) LMR 700/800 MHz - Land Mobile Radio
5) Frequencies for the following radio systems shall be supported. The DAS vendor shall confirm the frequencies required at the time of facility opening.

a) Federal DSH Trunk, 406.1 – 420 MHz NB
b) DVAMC Police 407.0750, 412.3875, and 416.0750 MHz
c) Local PD
d) City PD
e) County Sheriff
f) Fire Department
g) Internal Facilities

f. SMR (800 - 900MHz) - Nextel (old Spectralink)
g. One/two way paging (900MHz) – PCS (USA Mobility - 940.8625MHz)

6. The System shall have the capability for separate control over each service (or wireless operator) to allow the ability to adjust and control power levels without disturbing other services/operators.
7. The System shall support multiple services in a modular architecture so services can be added or removed without requiring new infrastructure, without readjustment of signal power levels, or disturbing existing services.
8. The System shall enable services to be added without requiring additional cabling or antennas.
9. The System shall not impede any management features or functionality of any attached network and/or device management system. The System shall allow for proactive management and end-to-end alarming of active equipment components, resulting in rapid problem identification and resolution. The System shall be able to integrated with 3rd party SNMP based element management systems via Ethernet and provide fault management information.

10. Cellular services:

    a. The System's transmission media can take many forms, from traditional off-air repeater, or Base Transceiver Station (BTS) to a tethered architecture consisting of coaxial, fiber optic, or hybrid fiber/coaxial base solution. The DAS shall extend the common wireless carrier services from the head end system by interfacing to either a passive or active DAS that is deployed in each of the building structures. The following system solution designs are meant to be typical only. Bidders are expected to describe their proposed system solution.
    b. The System shall support the use of legacy cellular enhancement and technologies such as GSM, EDGE, and UMTS-HSPA technologies.
    c. The GPS navigational signal must be brought to the Base Station at the System's head end to support LBS functionality.

11. The System shall support Owner's 2-way, non-IP communications radio systems.
12. The System and the associated wireless devices shall comply with FCC's and Regional regulatory authorities' emission rules for wireless devices.

    a. Refer to: FCC advisory: "A Local Government Official's Guide to Transmitting Antenna RF Emission Safety Rules, Procedures, and Practical Guidance", FCC's OET Bulletin 65, FCC Rule 47-part 17 and (ANSI/IEEE C95.1-1992) Hazardous Emission document.

13. Cabling

    a. Fiber optic cabling is specified in Section 27 15 00 and provided on special systems fiber optic backbone riser diagrams. Contractor shall identify in shop drawing submittal one-line diagram the mode and number of stands required.
    b. 50 ohm coaxial cable and terminations are specified in 27 15 00.

14. Interference: There shall be no interference between the applications and wireless operators specified in this Section.

C. Base Bid Work

1. The work of this section includes furnishing materials, installation, and coordination through the General Contractor with other trades for a complete, operational, and balanced System. Furnish necessary materials, accessories, fasteners, etc., and the labor and associated services required to provide the System specified herein.
2. The work of this section includes the following (described in greater detail in Part 3):

    a. Project management services
    b. Detailed System Design
    c. Installation and system balancing
    d. Coordination with the overall construction team and usage of pathways provided by others
    e. Manage Public Safety Radio Enhancement / Emergency Responder services connection to System
    f. Manage Wireless Service Providers' connection to System
    g. Manage Integration with 2-way radio systems Integrator
    h. Manage FCC Licensing
    i. System acceptance testing and turn over to Owner

3. The work of this section requires particular attention to the following:

    a. Ceiling Types: The installer shall fully understand every ceiling type and its interaction with the System. For example, some ceiling types may impede RF signals and, subsequently, System performance.
    b. Pathways: The work of this section requires the installer fully understand the pathways and to coordinate placement of cables within those pathways.

D. Coordination with other Sections

1. Pathways – backbone conduits and primary pathways
2. Telecommunications Rooms – equipment support racks, cabinets, power, cooling, and grounding
3. Wired IT Ethernet network

1.6 SUBMITTALS

A. Comply with the Submittal portions of Division 27. Provide Submittal information for the following Submittal sections as described below:

1. Product Data Submittal

    a. Product Data Submittals shall conform to the general requirements and procedure outlined in Division 27.

2. Shop Drawings Submittal. Shop drawings shall include the following information:

    a. Provide initial site wireless survey report.
    b. Provide a detailed textual narrative with sufficient detail to illustrate the proposed System.
    c. Detailed system one-line or functional block/line diagrams.
    d. Plans indicating equipment, antenna, and/or component locations, cable routes, and other installation information – identify construction elements that would affect the System's performance (such as metallic ceiling materials).
    e. Predictive modeling coverage plans, showing the design RF coverage (signal strength) for each frequency band required in 1.04 B.3.
    f. Cellular coverage information will include dBm above the exterior macro. Note that 700 MHz now requires -75 dBm MIMO 2x2 throughout the cellular coverage areas.
    g. Equipment, wall, and rack elevations, showing equipment layout, pathway, power, cooling, and space requirements for the System and for the Wireless Service Providers and integration with other systems outside the scope of the DAS (e.g. Fire Alarm Systems, Ethernet network monitoring).
    h. Installation details for antenna mounting, specialty cable hangers, grounding and other components unique to the System, and other information that depicts the intended installation.
    i. The design data furnished by the Contractor shall be sufficient to enable the Engineer to determine whether or not the equipment, materials, and installation the Contractor proposes comply with the requirements of this Specification.

3. Substitutions

   a. Requests for substitutions shall conform to the general requirements and procedure outlined in Division 27.

4. Submittal Requirements Prior To Acceptance Testing:

   a. Acceptance Testing Procedures Submittal: describe in detail the procedure for testing the System's performance and balancing the System's signal strength, including a description of the test data (or an example of the test report). The Contractor shall demonstrate the desired services have been successfully deployed and tested. Specifically, the DAS must be deployed with the Wireless Operators criteria and approval.

5. Submittal Requirements at Close Out:

   a. As-Built Drawings Submittal
   b. Record Drawings Submittal
   c. Operations and Maintenance Manual (refer to Division 27)
   d. Integration of components and pathways into the Building Information Model (BIM)

B. Sustainable Design Submittals: Submit the necessary documentation to verify compliance with requirements specified in Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Submit in accordance with Division 27.

1.8 QUALITY ASSURANCE

A. Quality Assurance: The Contractor shall provide detailed quality control and checking of each item of equipment and materials provided during each portion of the installation, the final installation, and remedy any and all defects therein.

B. Comply with Quality Assurance requirements Division 27.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with Delivery, Storage and Handling requirements Division 27.

1.10 WARRANTY

A. Warrant Work and System to perform as described within this Section for duration indicated in Division1, including components, electronics, etc., and coverage. Correct deficiencies within 24 hours of notification.

PART 2 - MATERIALS

2.1 MANUFACTURERS

A. Unless otherwise indicated, equipment in this Section shall be the standard products of a manufacturer regularly engaged in the manufacture of such products. All components used in the system shall be commercial products that comply with the Specifications. Each major component of equipment shall identify the manufacturer's name, model and serial number. The Resident Engineer retains the right to reject products which reflect, in the Resident Engineer's opinion, sub-standard design practices, manufacturing procedures, support services, or warranty policies. Refer to drawing project notes for additional manufacturer information.

2.2 COMPONENTS

A. Copper coaxial and fiber optic cables shall be plenum rated above ceiling at 3rd floor concourse. Match cable requirements indicated elsewhere in Division 27, unless otherwise indicated.

B. Fiber optic transport: If fiber optic transport is utilized, the IWS shall utilize single-mode fiber with angle polished connectors (APC) to distribute signals.

C. Broadband (coaxial) distribution: If broadband distribution is utilized, the IWS shall use coaxial cable in the horizontal runs and passive (i.e. non-powered) broadband antennae in the distribution area.

2.3 OMNI-DIRECTIONAL COVERAGE

A. Omni-Directional Coverage antennas shall feature a multi-band design, accommodating multiple frequency bands in a single small antenna.

1. Electrical Band 1:

   a. Frequency Band: 698 – 800 MHz
   b. VSWR: ≤ 1.8:1
   c. Gain: ≥ 1.5 dBi
   d. Maximum input power:
   e. Impedance: 50 Ω
   f. Beamwidth, Horizontal: 360° omnidirectional
   g. Beamwidth, Vertical: 80° nominal
   h. Return Loss: 10.9 dB

2. Electrical Band 2:

   a. Frequency Band: 1710 – 2700 MHz and 800 – 960 MHz
   b. VSWR: ≤ 1.5:1
   c. Gain: ≥ 1.5 dBi @ 800–960 MHz and ≥ 5.0 dBi @ 1710 – 2700 MHz
   d. Maximum input power:
   e. Impedance: 50 Ω
   f. Beamwidth, Horizontal: 360° omnidirectional
   g. Beamwidth, Vertical: 65° nominal
   h. Return Loss: ≤ 13.9 dB

3. Mechanical:

    a. Connector: 50 Ω N Type Female
    b. Mounting: Thru-hole ceiling mount
    c. Radome material: ABS, UV resistant
    d. Pigtail cable: KSR195, plenum rated

4. Environmental:

    a. Application: Indoor
    b. Operating Temperature: 40 °C to +60 °C (40 °F to +140 °F)
    c. Relative Humidity: Up to 100%

5. Regulatory Compliance/Certifications: RoHS 2002/95/EC

B. Directional Coverage Antennas: Directional coverage antennas shall feature a multi-band design, accommodating multiple frequency bands in a single small antenna.

1. Electrical Band 1:

    a. Frequency Band: 698 – 800 MHz
    b. VSWR: ≤ 1.8:1
    c. Gain: ≥ 5.0 dBi @ 698 – 800 MHz
    d. Maximum input power: 50W
    e. Impedance: 50 Ω
    f. Beamwidth, Horizontal: 110° nominal
    g. Polarization: Vertical
    h. Return Loss: ≤ 10.9 dB

2. Electrical Band 2:

    a. Frequency Band: 1710 – 2700 MHz and 800 – 960 MHz
    b. VSWR: ≤ 1.5:1
    c. Gain: ≥ 5.0 dBi @ 800 – 960 MHz and ≥ 6.0 dBi @ 2170 – 2700 MHz and ≥ 8.0 dBi @ 1710 – 2170 MHz
    d. Maximum input power:
    e. Impedance: 50 Ω
    f. Beamwidth, Horizontal: 90° nominal
    g. Return Loss: ≤ 13.9 dB

3. Mechanical:

    a. Connector: 50 Ω N Type Female
    b. Mounting: 4-hole wall mounting plate
    c. Radome material: ABS, UV resistant
    d. Pigtail cable: RG58, plenum rated

4. Environmental:

    a. Application: Indoor
    b. Operating Temperature: 40 °C to +60 °C (40 °F to +140 °F)
    c. Relative Humidity: Up to 100%

5. Regulatory Compliance/Certifications: RoHS 2002/95/EC

PART 3 - EXECUTION

3.1 GENERAL

A. Work shall comply with the Governing Requirements as defined in Division 27.

B. Public Safety IWS shall be integrated into the fire alarm panel, per AHJ requirements and Manufacturer's recommendations, and shall be monitored remotely.

3.2 EXAMINATION AND PREPARATION

A. Prior to the start of this Section's installation Work, examine Communications Rooms and Pathways for completeness, compatibility with the Work of this section, and readiness for connections with the Work of this section.

3.3 INSTALLATION

A. Project Management Services: The Contractor shall assign a single-point-of contact "Project Manager" (PM) to this project with overall responsibility for communications and ultimate delivery of contracted materials, installation, performance criteria, and services. This PM shall be responsible for interfacing with the VA, General Contractor, Engineer, and their own subcontractors. The PM shall present the design iterations to the Owner and Engineer, coordinate cable routes and equipment locations with the Engineer, coordinate on-site construction activities with the General Contractor, shall manage the process to coordinate bringing wireless operators into the facility, and shall close out the project with the Owner.

B. Detailed System Design: The Contractor shall use the criteria and requirements of this Section to complete the detailed design of the System. Design shall include computer RF modeling and site surveys. The detailed design shall deliver the pre-construction submittals, including iterations for the Owner's review and sign-off. The Contractor shall be able to show design RF signal levels to subroom precision for all rooms within the defined coverage areas. The Contractor will obtain compatible drawings from architect. If drawings are within BIM then it is the responsibility of the contractor to modify the BIM model for use in their wireless modeling which includes the creation of 2-D floor plans, Reflected Ceiling Plans (RCP) and elevations.

C. Installation: The Contractor shall coordinate the installation and schedule with the Owner and General Contractor prior to the start of installation activities. Once the Owner and General Contractor have accepted the coordination and schedule, the Contactor may proceed with installation.

D. System Balancing: The Contractor shall balance the System component (e.g., antenna) signal strength to the device signal levels.

E. Active Survey: The Contractor shall perform an active wireless survey demonstrating performance according to the design criteria of Part 1 (above). From this survey, produce an active survey report, including floor plans.

3.4 CONNECTIONS TO SYSTEM

A. Manage Wireless Operators' Connection to System: The Contractor shall represent the Owner during negotiations with wireless operators, coordinate site preparation, assist with wireless service providers' installation, and coordinate connection of wireless service providers to the System. The Wireless Operator integration shall be turn-key. Integration includes BDA(s), donor antennae, and updated telecommunication drawings.

B. Manage FCC License: Acting as a representative of the Owner, obtain required licenses for operation under FCC Regulations.

3.5 LABELING

A. General Requirements

1. Labeling, identifier assignment, and label colors shall conform to TIA/EIA-606-A Administration Standard and as approved by Owner's Representative before installation.
2. Permanently label equipment, components, and cables. Affix label as close as practical to each end of cables.
3. Coordinate labeling and identifier assignment with the Engineer or Owner. Submit a labeling plan to the Engineer for approval prior to labeling work.

B. Label Format

1. Provide permanent labels with machine-generated text; hand written labels will not be accepted.
2. Labels on cables shall fully wrap around conductors with a self-laminating feature to provide permanent marking.

3.6 SYSTEM ACCEPTANCE TESTING AND TURN OVER TO OWNER

A. Complete the acceptance testing as prescribed in the accepted Testing Procedures submittal.

B. Provide test results for Public Safety in the format approved by the AHJ. Coordinate and conduct acceptance testing with AHJ.

C. The Contractor shall perform signal strength testing throughout the building. Testing shall be performed using a portable spectrum analyzer or other approved test equipment and the field strength measurements recorded. Test results shall be compared to the requirements of the Performance Specification to determine compliance with this Specification.

1. Dual testing shall consist of the following:

a. Benchmark test: A signal of known strength shall be injected at the head end. Measurements shall be taken throughout the entire installation area using a portable spectrum analyzer or other approved test equipment and recorded.
b. Actual field strength measurements: Measurements shall be taken throughout the entire installation area at each of the frequencies reradiated over the IWS system and recorded.

2. Test results shall be compiled and submitted to provide evidence of compliance with this Performance Specification.

D. Upon approval of the test report by the Engineer and at a time established by the Engineer, present the completed System and wireless services to the Owner, including functionality, features, ongoing maintenance, and warranty procedures. Demonstrate to Owner and Engineer system operation, including signal strength at select locations. Turn over quantity of electronic records and printed records as indicated in Division 2.

3.7 FINAL INSPECTION AND CERTIFICATION

A. Comply with system acceptance and certification requirements of Divisions 1 and 27.

3.8 SYSTEM TRAINING

A. Comply with training requirements Division 27.

B. For this System and at the Owner's convenience, provide six (6) training sessions of six (6) hours duration each.

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