



**Department of
Veterans Affairs**

VOLUME 3 of 3 – COMMUNICATIONS, ELECTRONIC SAFETY AND SECURITY,
EARTHWORK, EXTERIOR IMPROVEMENTS, UTILITIES

VA SPECIFICATIONS

FOR

CONSOLIDATE PATIENT CARE SERVICES ADDITION TO BUILDING #170

FOR

CENTRAL ARKANSAS VETERANS HEALTHCARE SYSTEM

AT

NORTH LITTLE ROCK, ARKANSAS

**CENTRAL ARKANSAS VETERANS HEALTHCARE SYSTEM
CONSOLIDATE PATIENT CARE SERVICES ADDITION TO BUILDING #170**

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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.
- B. 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.

1.3 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project's sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute's Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.4 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 three years.
 - 2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been 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.

1.5 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 prior to final inspection and not more than 90 days after completion of the tests.
 - 3. 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.

1.6 EQUIPMENT REQUIREMENTS

- A. Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS 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.

1.7 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.

1.8 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 the GENERAL CONDITIONS.

1.9 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. 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. "Conveniently 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.

1.10 EQUIPMENT IDENTIFICATION

- A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.
- 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, or where other method of identification is herein specified, are exceptions.

1.11 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 cut sheets, shop drawings, and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cut sheets submitted for approval shall be legible and clearly identify equipment 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. Elementary 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.
 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. Furnish four copies, bound in hardback binders, (manufacturer's standard 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.
 - i. 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.

- j. 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.
- I. 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.

1.12 SINGULAR NUMBER

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.

1.13 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.

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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 all electrodes required by NEC, as well as including made, supplementary, telecommunications system grounding electrodes.
- C. The terms “connect” and “bond” are used interchangeably in this specification and have the same meaning.

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: Low Voltage power and lighting wiring.
- C. Section 26 41 00, FACILITY LIGHTNING PROTECTION: Requirements for a lightning protection system.

1.3 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project’s sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute’s Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.4 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.

- 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 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 and tested.

1.5 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the 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.

- A. American Society for Testing and Materials (ASTM):
 - B1 Standard Specification for Hard-Drawn Copper Wire
 - B8 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 81-08 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
- C. National Fire Protection Association (NFPA):
 - 70-11 National Electrical Code (NEC)
- D. Telecommunications Industry Association, (TIA)
 - J-STO-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- E. Underwriters Laboratories, Inc. (UL):
 - 44 Thermoset-Insulated Wires and Cables
 - 83 Thermoplastic-Insulated Wires and Cables
 - 467 Grounding and Bonding Equipment
 - 486A-486B 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 STO-607A. Use a minimum 50mm² (1/0 AWG) insulated stranded copper grounding conductor 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.

2.3 SPLICES AND TERMINATION COMPONENTS

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

2.4 TELECOMMUNICATION SYSTEM GROUND BUSBARS

- A. Provide solid copper busbar, pre-drilled from two-hole lug connections with a minimum thickness of 6 mm (1/4 inch) for wall and backboard mounting using standard insulators sized as follows:
 - 1. Room Signal Grounding: 300 mm x 100 mm (12 inches x 4 inch).
 - 2. Master Signal Ground: 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: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
 - 3. Rack and Cabinet Ground Bars: one-hole 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 3/4 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. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
- E. Boxes, Cabinets, Enclosures, and Panelboards:
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.
- F. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

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.
- B. In operating rooms and at intensive care and coronary care type beds, bond the gases and suction piping, at the outlets, directly to the room or patient 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: 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.

3.8 COMMUNICATIONS CABLE GROUNDING

- A. Bond all metallic cable sheaths in multipair communications cables together at each splicing and/or terminating location to provide 100 percent metallic sheath continuity throughout the communications distribution system.
 - 1. At terminal points, install a cable shield bonding connector and provide a screw stud connection for ground wire. Use a bonding jumper to connect the cable shield connector to an appropriate ground source like the rack or cabinet ground bar.
 - 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 system 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 splice 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 rack pan.

3.10 COMMUNICATIONS 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.

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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: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

- A. Bedding of conduits: Section 31 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 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project's sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute's Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.4 SUBMITTALS

In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

- A. Shop Drawings:
 - 1. Size and location of panels and pull boxes
 - 2. Layout of required conduit penetrations through structural elements.
 - 3. The specific item proposed and its area of application shall be identified on the catalog cuts.
- B. Certification: 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.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the 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):
 - 70-11National Electrical Code (NEC)
- C. Underwriters Laboratories, Inc. (UL):
 - 1-03Flexible Metal Conduit
 - 5-01Surface Metal Raceway and Fittings
 - 6-03Rigid Metal Conduit
 - 50-03Enclosures for Electrical Equipment
 - 360-03Liquid-Tight Flexible Steel Conduit
 - 467-01Grounding and Bonding Equipment
 - 514A-01Metallic Outlet Boxes
 - 514B-02Fittings for Cable and Conduit
 - 514C-05Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
 - 651-02Schedule 40 and 80 Rigid PVC Conduit
 - 651A-03Type EB and A Rigid PVC Conduit and HDPE Conduit
 - 797-03Electrical Metallic Tubing
 - 1242-00Intermediate Metal Conduit

D. National Electrical Manufacturers Association (NEMA):

TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and Tubing

FB1-03Fittings, Cast Metal Boxes and Conduit Bodies for Conduit,
Electrical Metallic Tubing and Cable

PART 2 - PRODUCTS

2.1 MATERIAL

A. Conduit Size: In accordance with the NEC, but not less than 13 mm (1/2 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.

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 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 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. 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 square with a hacksaw, ream, 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.
- 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 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. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (six feet) of flexible metal conduit extending from a junction box to the fixture.
4. 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. 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.
- C. Align and run conduit parallel or perpendicular to the building lines.
- D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- E. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.
- F. Surface metal raceways: Use only where shown.
- G. Painting:
 1. Paint exposed conduit as specified in Section 09 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 19 mm (3/4 inch), but not less than the size shown on the drawings.
- C. All conduit ends shall be equipped with insulated bushings.
- D. All 100 mm (4 inch) conduits within buildings shall include pull boxes after every two 90 degree bends. Size boxes per the NEC.
- E. Vertical conduits/sleeves through closets floors 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.

- 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 four quarter turns (90 degree bends) between pull boxes/backboards. Minimum radius of communication conduit bends shall be as follows (special long radius):

Sizes of Conduit Trade Size	Radius of Conduit Bends mm, Inches
3/4	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

- 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).

--- E N D ---

**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 31 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 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project's sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute's Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS FOR GREEN GLOBES™ CERTIFICATION.

1.4 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.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the 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. American Society of Testing Material (ASTM):
D2301.....Standard Specification for Vinyl Chloride Plastic Pressure
Sensitive Electrical Insulating Tape
- C. Federal Specifications (Fed. Spec.):
A-A-59544.....Cable and Wire, Electrical (Power, Fixed Installation)
- D. National Fire Protection Association (NFPA):
70-11National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
44Thermoset-Insulated Wires and Cables
83Thermoplastic-Insulated Wires and Cables
467Electrical Grounding and Bonding Equipment
486A.....Wire Connectors and Soldering Lugs for Use with Copper
Conductors
486C.....Splicing Wire Connectors
486D.....Insulated Wire Connector Systems for Underground Use or in
Damp or Wet Locations
486E.....Equipment Wiring Terminals for Use with Aluminum and/or
Copper Conductors
493Thermoplastic-Insulated Underground Feeder and Branch Circuit
Cable
514B.....Fittings for Cable and Conduit
1479Fire Tests of Through-Penetration Fire Stops

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.
- C. Shall be Polywater FTTX for all data cables routed in conduit lengths of 150 feet or more

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.
5. Provide Polywater FTTX lubricant for all data cables routed in conduit lengths of 150 feet or more,

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. Fireproofing:
 1. Install fireproofing where low voltage cables are installed in the same manholes with high voltage cables; also cover the low voltage cables with arc proof and fireproof tape.
 2. Use tape of the same type as used for the high voltage cables, and apply the tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (one inch) into each duct.
 3. Secure the tape in place by a random wrap of glass cloth tape.

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.
- 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 EXISTING 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.

- - - E N D - - -

SECTION 27 11 00
COMMUNICATIONS EQUIPMENT ROOM FITTINGS

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 Substance Abuse Building and the Patient Consolidation Services Building here-in-after referred to as “the Facility”. The System shall include, but not be limited to: equipment cabinets, interface enclosures, and relay racks; necessary combiners, traps, and filters; and necessary passive devices such as: splitters, couplers, cable “patch”, “punch down”, and cross-connector blocks or devices, voice and data distribution sub-systems, and associated hardware. The System shall additionally include, but not be limited to: telecommunication closets (TC); telecommunications outlets (TCO); copper and fiber optic, connectors, “patch” cables, and/or “break out” devices.
- B. The System shall be delivered free of engineering, manufacturing, installation, and functional defects. It shall be designed, engineered and installed for ease of operation, maintenance, and testing.
- C. The term “provide”, as used herein, shall be defined as: designed, engineered, furnished, installed, certified, and tested, by the Contractor.
- D. The Voice and Digital Telecommunication Distribution Cable Equipment and System provides the media which voice and data information travels over and connects to the 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.

- E. 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.

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Section 27 10 00, STRUCTURED CABLING.
- E. Section 26 27 26, WIRING DEVICES.
- F. Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- G. Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- H. Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT - EXTENSION.
- I. Section 27 41 41, MASTER ANTENNA TV EQUIPMENT AND SYSTEMS - EXTENSION.

1.3 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project's sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute's Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.4 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):
 - 70-11 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:
 - 568B..... Commercial Building Telecommunications Wiring Standard
 - 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. Lucent Technologies: Document 900-200-318 “Outside Plant Engineering Handbook”.
- F. International Telecommunication Union – Telecommunication Standardization Sector (ITU-T).
- G. Federal Information Processing Standards (FIPS) Publications.
- H. Federal Communications Commission (FCC) Publications: Standards for telephone equipment and systems.
- I. United States Air Force: Technical Order 33K-I-IOO Test Measurement and Diagnostic Equipment (TMDE) Interval Reference Guide.
- J. Joint Commission on Accreditation of Health Care Organization (JCAHO): Comprehensive Accreditation Manual for Hospitals.

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

1.5 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.

1.6 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. The 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. Environmental Requirements: Technical submittals shall confirm the environmental specifications for physical TC areas occupied by 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 Contractor shall provide the specific voltage, amperage, phases, and quantities of circuits required.
 5. Air conditioning, heating, and humidity requirements. The Contractor 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 main TC, computer, and console rooms).
 9. Main trunk line and riser pathways, cable duct, and conduit requirements between each MTC, TC, and TCO.
- C. Documents: The submittal shall be separated into sections for each subsystem and shall contain the following:
1. Title page to include:
 - a. VA 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. The following is the minimum equipment required by the system:

QUANTITY	UNIT
As required	Cabinet Assembly(s)
As required	Environmental Cabinet
As required	Distribution/Interface Cabinet
As required	Equipment (Radio Relay) Rack
As required	Cross Connection (CCS) Systems
As required	Audio Alarm Panel
As required	TROUBLE ANNUNCIATOR PANEL
As required	Lightning Protection System
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	Terminators
As required	Distribution Frames
As required	Telecommunications Closets (TC)
As required	Environmental Requirements
1 ea.	Installation Kit
As required	Separate List Containing Each Equipment Spare(s)

5. Pictorial layouts of each MTC, IMTC, and RTCs; MCCS, IMCCS, VCCS, and HCCS termination cabinet(s), each distribution cabinet layout drawing, and TCO as each is expected to be installed and configured.
6. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
7. 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 multipin, fiberoptic, and coaxial cable jack.
8. List of test equipment as per paragraph 1.5.D. below.

9. Letter certifying that the Contractor understands the requirements of the SAMPLES Paragraph 1.5.E.
10. Letter certifying that the Contractor understands the requirements of Section 3.2 concerning acceptance tests.

D. 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 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).
 - f. Camera with a minimum of 60 pictures to that will develop immediately to include appropriate test equipment adapters. A video camera in VHS format is an acceptable alternate.

E. 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 4" x 4"x 2.5" with:
 - a. Two (2) each telephone (or voice) RJ45 jack installed.
 - b. Two (2) multi pin data RJ45 jacks installed.
 - c. Cover Plate installed.
2. Data CCS patch panel, punch block or connection device with RJ45 connectors installed.
3. Telephone CCS system with IDC and/or RJ45 connectors and cable terminal equipment installed.
4. Fiber optic CCS patch panel or breakout box with cable management equipment and "ST" connectors installed.

5. 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.
6. 610 mm (2 ft.) section of each fiber optic cable to be used with cable sweep tags as specified in paragraph 2.4.H and connectors installed.

F. 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.

G. 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.

H. 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 (AutoCAD) system. The RE shall verify and inform the Contractor of the version of AutoCAD being used by the Facility.

I. 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 on site 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:

<u>EQUIPPED ITEM</u>	<u>CAPACITY</u>	<u>WIRED CAPACITY</u>
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		

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” and/or “Bus” Topology.

- 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. Provide T-1 access/equipment (or CSU), as required for use, in FTS and other trunk applications by system design if this equipment is not provided by the existing telephone system and/or will be deactivated by the installation of the System. The Contractor shall provide all T-1 equipment necessary to terminate and make operational the quantity of circuits designated. The CSU's shall be connected to the System's emergency battery power supply. The System shall be fully capable of operating in the Industry Standard “DS” protocol and provide that service when required.
- d. Where the System connects to an existing or future telephone system, refer to Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT - EXTENSION for specific telephone equipment and system operational performance standards.

2. 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: “Main” (MTC), “intermediate” (IMTC), and “riser” (RTC) TC’s; “vertical” (or “riser”) trunk cabling system; vertical cross-connection (VCC) cabling systems, 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. Telecommunication Closet (TC):
- 1) There shall be a minimum of one TC for the MTC, each building IMTC, and each RTC per building floor location. However, in large building(s), where the horizontal distance to the farthest voice and digital work area may exceed 90 Meters (M) (or 295 feet [ft]), additional TC’s shall be provided as described herein. The maximum DC resistance per cable pair shall be no more than 28.6 Ohms per 305 M (1,000 feet). Each TC shall be centrally located to cover the maximum amount of local floor space. The TC’s house in cabinets or enclosures, on relay racks, and/or on backboards, various telecommunication data equipment, controllers, multiplexers, bridges, routers, LAN hub(s), telephone cross-connecting, active and passive equipment.
 - 2) Additionally, the TC’s may house fire alarm and video equipment. Regardless of the method of installation, mounting, termination, or cross-connecting used, all vertical copper and fiber optic cables shall be terminated on appropriate cross-connection systems (CCS) containing patch panel(s), punch blocks, and/or breakout devices provided in enclosures and tested as described herein. A cable and/or wire management system shall be a part of each CCS.
- a) A minimum of three 110-120 VAC active quad outlets shall be provided, each with “U” grounded receptacles at a minimum of one outlet for each front, side and back wall. These outlets shall be separately protected by an AC circuit breaker provided in the designated Government Emergency Critical Care AC power panel, that is connected to the Facilities Emergency AC Power Distribution System. For larger building TC applications, a minimum of one additional quad AC outlet shall be provided for every 800M² (or 8,000 ft²) of useable floor space. Additional outlets shall be equally spaced along the wall.

- b) Climate control shall be provided in each TC 24 hours a day, seven days per week and 52 week per year to prevent failure of electronic components and for mission critical functional applications. The RE is responsible for informing the Contractor regarding the minimum climate control requirements. In identified hostile TC locations where it has been determined (by the RE) that proper TC climate or external signal radiation cannot be properly maintained or controlled, the Contractor may, at his/her option, provide a minimum of two individual and properly sized self contained climate controlled equipment cabinet enclosures; one designated for voice and one designated for data service, in each TC location identified on the drawings, in lieu of providing additional required TC air handling capability.

B. System Performance:

- 1. 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) \pm 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 \pm 0.1 dBmV.
- d) System speed: 120 mBps, minimum.
- e) System data error: 10 to the -8 Bps, minimum.

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.
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. The Telephone Contractor is responsible for providing interfacing cable connections for the telephone systems with the System.
5. The telephone equipment shall be the interface points for connection of the telephone systems cabling from the telephone switch via the system telephone interface unit.

6. Active electronic component equipment shall consist of solid state components, be rated for continuous duty service, comply with the requirements of FCC standards for telephone equipment, systems, and service.
7. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications.
8. All interconnecting twisted pair, fiber-optic, or coaxial cables shall be terminated on equipment terminal boards, punch blocks, breakout boxes, splice blocks, and unused equipment ports/taps shall be terminated according to the OEM's instructions for telephone cable systems without adapters. The Contractor shall not leave unused or spare twisted pair wire, fiber-optic, or coaxial cable unterminated, unconnected, loose or unsecured.
9. Color code all distribution wiring to conform to the Telephone Industry standard, EIA/TIA, this document, and the requirements mandated on the drawings, whichever 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. Reference Section 27 10 00, STRUCTURED CABLING and Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT - EXTENSION.
10. Connect the System's primary input AC power to the Facility's Critical Branch of the Emergency AC power distribution system as shown on the plans or if not shown on the plans consult with RE regarding a suitable circuit location prior to bidding.
11. Plug-in connectors shall be provided to connect all equipment, except coaxial cables and interface points. Coaxial cable distribution points and RF transmission lines shall use coaxial cable connections recommended by the cable OEM and approved by the System OEM. Base-band cable systems shall utilize barrier terminal screw type connectors, at a minimum. Crimp type connectors installed with a ratchet type installation tool are and acceptable alternate as long as the cable dress, pairs, shielding, grounding, and connections and labeling are provided the same as the barrier terminal strip connectors. Tape of any type, wire nuts, or solder type connections are unacceptable and will not be approved.
12. All equipment faceplates utilized in the System shall be stainless steel, anodized aluminum, or UL approved cycloc plastic for the areas where provided.

13. Noise filters and surge protectors shall be provided for each equipment interface cabinet, switch equipment cabinet, control console, local, and remote active equipment locations to ensure protection from input primary AC power surges and noise glitches are not induced into low Voltage data circuits.

Underground warning tape shall be standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable, red with black letters imprinted with “CAUTION BURIED ELECTRIC LINE BELOW”, orange with black letters imprinted with “CAUTION BURIED TELEPHONE LINE BELOW” or orange with black letters imprinted with “CAUTION BURIED FIBER OPTIC LINE BELOW”, as applicable.

D. Equipment Functional Characteristics:

FUNCTIONS	CHARACTERISTICS
Input Voltage	105 to 130 VAC
POWER LINE FREQUENCY	60 HZ \pm 2.0 HZ
Operating Temperature	0 to 50 degrees (°) Centigrade (C)
Humidity	80 percent (%) minimum rating

E. Equipment Standards and Testing:

1. The System has been defined herein as connected to systems identified as Critical Care performing Life Support Functions. Therefore, at a minimum, the system shall conform to all aforementioned National and/or Local Life Safety Codes (which ever are the more stringent), NFPA, NEC, this specification, JCAHCO Life Safety Accreditation requirements, and the OEM recommendations, instructions, and guidelines.
2. All supplies and materials shall be listed, labeled or certified by UL or a nationally recognized testing laboratory where such standards have been established for the supplies, materials or equipment. See paragraph minimum requirements Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, and the guidelines listed in paragraph 2.J.2.
3. The provided active and passive equipment required by the System design and approved technical submittal must conform with each UL standard in effect for the equipment, as of the date of the technical submittal (or the date when the RE approved system equipment necessary to be replaced) was technically reviewed and approved by VA. Where a UL standard is in existence for equipment to be used in completion of this contract, the equipment must bear the approved UL seal.

4. Each item of electronic equipment to be provided under this contract must bear the approved UL seal or the seal of the testing laboratory that warrants the equipment has been tested in accordance with, and conforms to the specified standards.

2.2 EQUIPMENT ITEMS

A. Cabinet with Internal Equipment Mounting Rack:

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. A minimum of one cabinet shall be provided with blank rack space, for additional equipment. Blank panels shall be installed to cover any open or unused rack space. In addition, provide two 120 VAC power strips connected to surge protectors, a ventilation fan with non-disposable air filter, and a conduit or cable duct interfaced to adjacent cabinet(s), as part of this cabinet.
3. Blank panels shall be color matched to the cabinet, 3.175 mm (1/8 in.) aluminum with vertical dimensions in increments of one rack unit 45 mm (or 1.75 in.) with mounting holes spaced to correspond to EIA 480 mm (or 19 in.) rack dimensions. Single standard size blank panels shall be used to fill unused panel or rack spaces in lieu of numerous 45 mm (1.75 in.) types. One blank 45 mm (1.75 in.) high blank panel shall be installed between each item of equipment.
4. Technical Characteristics:

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

5. Internal Cabinet Components (minimum required):

a. AC power outlet strip(s):

1) Power outlet strip(s) shall be provided as directed by the RE or the IRM. The additional equipment cabinet with no installed items in the cabinet, shall contain strip(s) with a minimum of 12 ea. AC power outlets. Each strip shall be mounted inside and at the rear of the cabinet. It shall contain “U” 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 capacity 20 Ampere (AMP), 120 VAC continuous duty.
- b) Wire gauge: Three conductor, #12 AWG copper.

b. Cabinet AC Power Line Surge Protector and Filter:

1) Each cabinet shall be equipped with an AC Surge Protector and Filter. The Protector and Filter shall be housed in one single enclosure. The Protector and Filter shall perform instantaneous regulation of the AC input voltage and isolate and filter any noise present on the AC input line. The unit shall be equipped with AC voltage and current surge protectors to prevent damage to the electronic equipment from power line induced voltage spikes, surges, lightning, etc. It shall be cabinet mounted and the cabinet AC power strip (maximum of two strips) may be connected to it as long as the system design is met.

2) Technical Characteristics:

Input Voltage range	120 VAC \pm 15%
Power capacity	20 AMP, 120 VAC
Voltage output regulation	\pm 3.0%
Circuit breaker	15 AMP, may be self contain
Noise filtering	Greater than -45 dB
AC outlets	Four duplex grounded types, minimum
Response time	5.0 ns
Surge suppression	10,000 AMPS
Noise suppression	
Common	-40 dB
Differential	-45 dB

- 3) Specific requirements for current and surge protection shall include:
 - a) Voltage protection threshold, line to neutral, starts at no more than 220 Volts peak. The transient voltage shall not exceed 300 volts peak. The Contractor shall furnish documentation on peak clamping voltage as a function of transient AMP.
 - b) Peak power dissipation minimum 35 Joules per phase, as measured for 1.0 mS at sub branch panels, 100 Joules per phase at branch panels and 300 Joules per phase at service entrance panels. The Contractor shall furnish an explanation of how the ratings were measured or empirically derived.
 - c) Surge protector must not short circuit the AC power line at any time.
 - (1) The primary surge protection components must be silicon semiconductors. Secondary stages, if used, may include other types of devices.
 - (2) Surge protectors shall incorporate a visual device which indicates whether the surge suppression component(s) is (are) functioning.
 - (3) Surge protection devices shall be UL listed.
 - (4) Voltage and current surge protectors shall be provided on all ancillary equipment provided by the Contractor.
 - d) Power dissipation 12,000 Watts (W) for 1.0 mS (or 12 Joules).
 - e) Voltage protection threshold starts at not more than 100 VAC.

B. Distribution or System Interface Cabinet:

1. The cabinet shall be constructed of heavy 16 gauge cold rolled steel, have top and side panels and hinged front and rear (front door only if wall mounted) doors. 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, contain integral and adjustable predrilled rack mounting rails or frame that allows front panel equipment mounting and access. When all equipment, doors and panels are installed, snap-in-place chrome trim strip covers are required to be installed that will cover all front panel screw fasteners. It shall be equipped the same as the equipment cabinet.
2. Technical Characteristics:

Overall height	2180 mm (85-7/8 in.), maximum
Overall depth	650 mm (25-1/2 in.), maximum
Overall width	535 mm (21-1/16 in.), maximum
Equipment vertical mounting space	1960 mm (77-1/8 in.), maximum
Front panel horizontal	484 mm (19-1/16 in.), maximum width

D. Stand Alone Equipment (or sometimes called Radio Relay) Rack:

1. If provided, 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 floor or wall mounted or mounted on casters as directed by the RE.
2. Technical Characteristics:

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

E. 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 (or Telephone):
 - 1) The CSS for voice or telephone service shall be Industry Standard type 110 (minimum) punch blocks for voice or telephone, and control wiring in lieu of patch panels, each being certified for category 6 service. IDC punch blocks (with internal RJ45 jacks) are acceptable for use in all CCS and shall be specifically designed for category 6 telecommunications service and the size and type of UTP cable used as described herein. As a minimum, punch block strips shall be secured to an OEM designed physical anchoring unit on a wall location in the MTC, IMTC, RTC, and TC. However, console, cabinet, rail, panel, etc. mounting is allowed at the OEM recommendation and as approved by the RE. Punch blocks shall not be used for Class II or 120 VAC power wiring.

2) Technical Characteristics:

Number of horizontal rows	100, MINIMUM
Number of terminals per row	4, minimum
Terminal protector	required for each used or unused terminal
Insulation splicing	required between each row of terminals

b. Digital or High Speed Data:

- 1) The CSS for digital or high-speed data service shall be a patch panel with modular female RJ45 jacks installed in rows. Patch panels and RJ45 jacks shall be specifically designed for category 6 telecommunications service and the size and type of UTP or STP 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, minimum
Number of jacks per row	24, MINIMUM
Type of jacks	RJ45
Terminal protector	required for each used or unused jack
Insulation	required between each row of jacks

c. Fiber optic

- 1) Product reference of a Government Approved (US State Department) type is Telewire, PUP-17 with pre-punched chassis mounting holes arranged in two horizontal rows. This panel may be used for fiber optic, audio, control cable, and Class II Low Voltage Wiring installations when provided with the proper connectors. This panel is not allowed to be used for 120 VAC power connections.

2) Technical Characteristics:

Height	Two rack units (RUs), 88 mm (3.5 in.) minimum
Width	484 mm (19-1/16 in.), EIA minimum
Number of connections	12 pairs, minimum
Connectors	“ST”
Audio Service	Use RCA 6.35 mm (1/4 in.) Phono, XL or Barrier Strips, surface mounted with spade lugs (punch block or wire wrap type strips are acceptable alternates for barrier strips as long as system design is maintained and RE approved)
Control Signal Service	Barrier strips surface mounted with spade lugs (punch block or wire wrap type strips are acceptable alternates for barrier strips as long as system design is maintained and RE approved)
Low voltage power (class II)	Barrier strips with spade lugs and clear full length plastic cover, surfaced mounted
Fiber optic	“ST” Stainless steel, female

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

2. 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.
3. 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.
4. Wire Wrap Strips: Industry Standard wire wrap strips (16.5 mm (0.065 in.) 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.

F. 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 TC 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.

2.3 ENVIRONMENTAL REQUIREMENTS: 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:

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

2.4 INSTALLATION KIT: 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:

- A. 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.
- B. 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.
- C. 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.
- D. 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.
- E. 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.
- F. 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.
- G. 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 vertical copper, fiber optic, and coaxial cables shall be terminated so any future changes only requires modifications of the existing 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 coaxial cables carrying telephone and data signals in telephone and data 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 19 mm (3/4 in.).
- 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 Articles 517 for Critical Care and 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, its 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.
- g. Ensure that Critical Care Systems (as identified by NEC Section 517) are completely separated and protected from all other systems.

2. Signal Duct, Cable Duct, or Cable Tray:
 - a. The Contractor shall use existing signal duct, cable duct, and/or cable tray, when identified and approved by the RE.
 - b. Approved signal and/or cable duct shall be a minimum size of 100 mm x 100 mm (4 in. X 4 in.) inside diameter with removable tops or sides, as appropriate. Protective sleeves, guides or barriers are required on all sharp corners, openings, anchors, bolts or screw ends, junction, interface and connection points.
- 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. Grounding:
 1. General: The Contractor shall ground all Contractor Installed Equipment and identified Government Furnished Equipment to eliminate all shock hazards and to minimize, to the maximum extent possible, all ground loops, common mode returns, noise pickup, crosstalk, etc. The total ground resistance shall be 0.1 Ohm or less.
 - a. The Contractor shall install lightning arrestors and grounding in accordance with the NFPA and this specification.

- b. Gas protection devices shall be provided on all circuits and cable pairs serving building distribution frames located in buildings other than the building in which the MDF is located or in any area served by an unprotected distribution system (manhole, aerial, etc.). The Contractor shall install the gas protection devices at the nearest point of entrance in buildings where protection is required and on the same circuits on the MDF in the telephone switch room.
 - c. Under no conditions shall the AC neutral, either in a power panel or in a receptacle outlet, be used for system control, subcarrier or audio reference ground.
 - d. The use of conduit, signal duct or cable trays as system or electrical ground is not acceptable and will not be permitted. These items may be used only for the dissipation of internally generated static charges (not to be confused with externally generated lightning) that may applied or generated outside the mechanical and/or physical confines of the System to earth ground. The discovery of improper system grounding shall be grounds to declare the System unacceptable and the termination of all system acceptance testing.
- 2. Cabinet Buss: A common ground buss of at least #10 AWG solid copper wire shall extend throughout each equipment cabinet and be connected to the system ground. Provide a separate isolated ground connection from each equipment cabinet ground buss to the system ground. Do not tie equipment ground busses together.
 - 3. Equipment: Equipment shall be bonded to the cabinet bus with copper braid equivalent to at least #12 AWG. Self grounding equipment enclosures, racks or cabinets, that provide OEM certified functional ground connections through physical contact with installed equipment, are acceptable alternates.
 - 4. Cable Shields: Cable shields shall be bonded to the cabinet ground buss with #12 AWG minimum stranded copper wire at only one end of the cable run. Cable shields shall be insulated from each other, faceplates, equipment racks, consoles, enclosures or cabinets; except, at the system common ground point. Coaxial and audio cables shall have one ground connection at the source; in all cases, cable shield ground connections shall be kept to a minimum.

I. Equipment Assembly:

1. Cabinets:

- a. Each enclosure shall be: floor or wall mounted with standard knockout holes for conduit connections or cable entrance; provide for ventilation of the equipment; have front and rear locking doors (except wall mounted cabinets that require only a front locking door); power outlet strip(s), and connector or patch panel(s).
- b. Rack (including freestanding radio relay) mounted equipment shall be installed in the enclosure's equipment adjustable mounting racks with equipment normally requiring adjustment or observation mounted so operational adjustment(s) can be conveniently made. Heavy equipment shall be mounted with rack slides or rails allowing servicing from the front of the enclosure. Heavy equipment shall not depend only upon front panel mounting screws for support. Equipment shall be provided with sufficient cable slack to permit servicing by removal of the installed equipment from the front of the enclosure. A color matched blank panel (spacer) of 44 mm (1.75 in.) high, shall be installed between each piece of equipment (active or passive) to insure adequate air circulation. The enclosure shall be designed for efficient equipment cooling and air ventilation. Each console or cabinet shall be equipped with a quiet fan and nondisposable air filter.
- c. Enclosures and racks shall be installed plumb and square. Each shall be permanently attached to the building structure and held firmly in place. Fifteen inches of front vertical space opening shall be provided for additional equipment.
- d. Signal connector, patch, and bulkhead panels (i.e.: data, control, etc.) shall be connected so that outputs from each source, device or system component shall enter the panel at the top row of jacks, beginning left to right as viewed from the front, which will be called "inputs". Each connection to a load, device or system component shall exit the panel at the bottom row of jacks, beginning left to right as viewed from the front, which will be called "outputs".
 - 1) Equipment located indoors shall be installed in metal racks or enclosures with hinged doors to allow access for maintenance without causing interference to other nearby equipment.
 - 2) Cables shall enter the equipment racks or enclosures in such a manner that allows all doors or access panels to open and close without disturbing or damaging the cables.
 - 3) All distribution hardware shall be securely mounted in a manner that allows access to the connections for testing and provides sufficient room for the doors or access panels to open and close without disturbing the cables.

- J. 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. Conduit, Cable Duct, and/or Cable Tray: The Contractor shall label all conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 meters (10 ft.) identifying it as the System. In addition, each enclosure shall be labeled according to this standard.
 4. Termination Hardware: The Contractor shall label workstation outlets and patch panel connections using color coded labels with identifiers in accordance with VA OI&T design guidelines and as indicated on the plans.

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 T568B pin assignments and cabling connections are in compliance with ANSI/EIA/TIA standards. Visually confirm Category 6 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:

1. 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 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 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.
2. Multimode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with ANSI/EIA/TIA-568-B.3 and ANSI/EIA/TIA-526-14A using Method A, Optical Power Meter and Light Source and/or Method B, OTDR. Perform verification acceptance test.
3. Single mode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with ANSI/EIA/TIA-568-B.3 and ANSI/EIA/TIA-526-7 using Method A, Optical Power Meter and Light Source and/or Method B, OTDR. Perform verification acceptance test.

E. Performance Testing:

1. Perform Category 6 tests in accordance with ANSI/EIA/TIA-568-B.1 and ANSI/EIA/TIA-568-B.2. Test shall include the following: wire map, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, propagation delay and delay skew.
2. Fiber Optic Links: Perform end-to-end fiber optic cable link tests in accordance with ANSI/EIA/TIA-568-B.3.

F. Total System Acceptance Test: The Contractor shall perform verification tests for UTP copper cabling system(s) and the multimode and single mode fiber optic 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.

3.3 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.

3.4 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 possession 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) 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 in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) 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 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 Substance Abuse Building here-in-after referred to as “the Facility”. The System shall include, but not be limited to: equipment cabinets, interface enclosures, and relay racks; necessary combiners, traps, and filters; and necessary passive devices such as: splitters, couplers, cable “patch”, “punch down”, and cross-connector blocks or devices, voice and data distribution sub-systems, and associated hardware. The System shall additionally include, but not be limited to: telecommunication closets (TC); telecommunications outlets (TCO); copper and fiber optic distribution cables, connectors, “patch” cables, and/or “break out” devices.
- B. The System shall be delivered free of engineering, manufacturing, installation, and functional defects. It shall be designed, engineered and installed for ease of operation, maintenance, and testing.
- C. The term “provide”, as used herein, shall be defined as: designed, engineered, furnished, installed, certified, and tested, by the Contractor.
- D. The Voice and Digital Telecommunication Distribution Cable Equipment and System provides the media which voice and data information travels over and connects to the 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.

- E. 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.

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Section 27 10 00, STRUCTURED CABLING.
- E. Section 26 27 26, WIRING DEVICES.
- F. Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- G. Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- H. Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT - EXTENSION.

1.3 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project's sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute's Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.4 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:

- 568B..... Commercial Building Telecommunications Wiring Standard
- 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. Lucent Technologies: Document 900-200-318 “Outside Plant Engineering Handbook”.

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

G. Federal Information Processing Standards (FIPS) Publications.

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

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

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

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

1.5 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.

1.6 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. The 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. Environmental Requirements: Technical submittals shall confirm the environmental specifications for physical TC areas occupied by 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 Contractor shall provide the specific voltage, amperage, phases, and quantities of circuits required.
 5. Air conditioning, heating, and humidity requirements. The Contractor 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 main TC, computer, and console rooms).
 9. Main backbone, trunk line, riser, and horizontal cable pathways, cable duct, and conduit requirements between each MTC, TC, and TCO.
- C. Documents: The submittal shall be separated into sections for each subsystem and shall contain the following:
1. Title page to include:
 - a. VA Medical Center.
 - b. Contractor's name, address, and telephone (including FAX) numbers.
 - c. Date of Submittal.
 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. Select the required equipment items quantities that will satisfy the needs of the system and edit as needed. Delete equipment items that are not required add additional items required, and renumber section as per system design. The following is the minimum equipment required by the system:

QUANTITY	UNIT
As required	Cabinet Assembly(s)
As required	Environmental Cabinet
As required	Distribution/Interface Cabinet
As required	Equipment (Radio Relay) Rack
As required	Cross Connection (CCS) Systems
As required	Audio Alarm Panel
As required	Trouble Annunciator Panel
As required	Lightning Protection System
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	Terminators
As required	Distribution Frames
As required	Telecommunications Closets (TC)
As required	Environmental Requirements
1 ea.	Installation Kit
As required	Separate List Containing Each Equipment Spare(s)

5. Pictorial layouts of each MTC, IMTC, and RTCs; MCCS, IMCCS, VCCS, and HCCS termination cabinet(s), each distribution cabinet layout drawing, and TCO as each is expected to be installed and configured.
6. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
7. 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 multipin and fiber optic jack.
8. List of test equipment as per paragraph 1.5.D. below.
9. Letter certifying that the Contractor understands the requirements of the SAMPLES Paragraph 1.5.E.
10. Letter certifying that the Contractor understands the requirements of Section 3.2 concerning acceptance tests.

D. 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 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).
 - f. Camera with a minimum of 60 pictures to that will develop immediately to include appropriate test equipment adapters. A video camera in VHS format is an acceptable alternate.

E. 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 4" x 4"x 2.5" with:
 - a. Two (2) telephone (or voice) rj45 jack installed.
 - b. Two (2) multi pin data rj45 jacks installed.
 - c. Cover Plate installed.
2. Data CCS patch panel, punch block or connection device with RJ45 connectors installed.
3. Telephone CCS system with IDC and/or RJ45 connectors and cable terminal equipment installed.
4. Fiber optic CCS patch panel or breakout box with cable management equipment and "ST" connectors installed.
5. 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.
6. 610 mm (2 ft.) section of each fiber optic cable to be used with cable sweep tags as specified in paragraph 2.4.H and connectors installed.

F. 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.

G. 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.

H. 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 (AutoCAD) system. The RE shall verify and inform the Contractor of the version of AutoCAD being used by the Facility.

I. 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 on site 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:

<u>EQUIPPED ITEM</u>	<u>CAPACITY</u>	<u>WIRED CAPACITY</u>
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		

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” and/or “Bus” Topology.

- 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. Provide T-1 access/equipment (or CSU), as required for use, in FTS and other trunk applications by system design if this equipment is not provided by the existing telephone system and/or will be deactivated by the installation of the System. The Contractor shall provide all T-1 equipment necessary to terminate and make operational the quantity of circuits designated. The CSU's shall be connected to the System's emergency battery power supply. The System shall be fully capable of operating in the Industry Standard “DS” protocol and provide that service when required.
 - d. Where the System connects to an existing or future telephone system, refer to Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT - EXTENSION for specific telephone equipment and system operational performance standards.
2. Cable Systems - Twisted Pair and Fiber optic:
- a. General:
 - 1) The Contractor shall be responsible for providing an extension of the existing system conforming to current and accepted telephone, and digital industrial/commercial 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 cable jackets shall be color coded as designated on the Contract Drawings, and shall match the corresponding TCO jack color.
 - 3) 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 Pathway Design Handbook H-088C3, 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.

- 4) The System cables shall be fully protected by cable duct, trays, wireways, conduit (rigid, thin wall, or flex), and when specifically approved, flexible innerduct. 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 innerduct is used, it shall be installed in the same manner as conduit.
- 5) 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.
- 6) 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.
- 7) 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.
- 8) All metallic cable sheaths, etc. shall be grounded by the Contractor (i.e.: risers, underground, station wiring, etc.) as described herein.
- 9) 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.
- 10) 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.

- 11) Measures shall be employed by the Contractor to minimize the radiation of RF noise generated by the System equipment so as not to interfere with audio, video, data, computer main distribution frame (MDF), telephone customer service unit (CSU), and electronic private branch exchange (EPBX) equipment the System may service.
- 12) 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. The as-installed drawings shall identify each cable as labeled, used cable, and bad cable pairs. Minimum test requirements are for impedance compliance, inductance, capacitance, signal level compliance, opens, shorts, cross talk, noise, and distortion, and split pairs on all cables in the frequency ranges specified. The tests required for data cable must be made to guarantee the operation of this cable at not less than 10 mega (m) Hertz (Hz) full bandwidth, fully channel loaded and a Bit Error Rate of a minimum of 10^{-6} at the maximum rate of speed. All cable installation and test records shall be made available at acceptance testing by the RE or Contractor and thereafter maintained in the Facility's Telephone Switch Room. All changes (used pair, failed pair, etc.) shall be posted in these records as the change occurs.
- 13) The Contractor shall coordinate with the RE and the IRM to provide all cable pairs/circuits from the existing Main Computer Room (MCR) (GK107-170) and establish circuits throughout the Facility for all voice, data, computer alarm (except fire alarm), private maintenance line, LAN, DHCP, and any low voltage circuits as described herein.
- 14) 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 or STP backbone cable and a fiber optic backbone cable, the UTP or STP 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 or STP 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:
- 1) In TC's, which are only served by a UTP or STP backbone cable, the cable shall be terminated on separate modular connecting devices (110A or equivalent) that are dedicated to data applications. In order to provide full service to all data cable pairs as identified in each TC/cabinet including spare capacity noted herein, the size of all vertical (riser) cables and/or outside cables serving these TC's shall be increased as required.
- c. Backbone and Trunk Cables:
- 1) The Contractor shall identify, in the technical submittal, the voice and data 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.

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 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 (4) UTP 24 AWG station wiring cable shall be installed from the top TCO jack to the TC and shall be of a type designed to support Category 6 communications (250 mega-Hertz [mHz] or above). At the jack location, terminate all four (4) pair on the RJ-45/11 jack. At the signal closet, all four pair shall be terminated on the modular punch down blocks dedicated to telephone applications.
- 2) A Four (4) UTP 24 AWG (in thermoplastic jacket unless otherwise specified by RE) station wiring cable shall be installed from each of the two (2) bottom TCO RJ-45 jacks (shall conform to EIA/TIA 568 Standard "T568A" and NFPA) to the TC and shall be of a type designed to support Category 6 communications (250 mHz or above).

f. Telecommunication Outlets (TCO), Jacks: All TCO's shall have a minimum of four (4) RJ-45 type jacks. The top jacks shall be an eight pin RJ-45/11 compatible jack, labeled, and designated for telephone applications only. The bottom two jacks shall be eight pin RJ-45 type unkeyed (sometimes called center keyed) jacks, labeled, and designated for data. The jacks shall be color coded as designated on the Contract Drawings, and shall match the corresponding cable jacket color.

g. 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 62.5/125 micron multi-mode, containing a minimum of 24 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) In the TC's and MCR, 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.
- 4) 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: “Main” (MTC), “intermediate” (IMTC), and “riser” (RTC) TC’s; “backbone” cabling (BC) system; “vertical” (or “riser”) trunk cabling system; “horizontal” (or “lateral”) sub-trunk cabling system, vertical and horizontal cross-connection (VCC and HCC respectively) cabling systems, 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. Telecommunication Closet (TC):
- 1) There shall be a minimum of one TC for the MTC, each building IMTC, and each RTC per building floor location. However, in large building(s), where the horizontal distance to the farthest voice and digital work area may exceed 90 Meters (M) (or 295 feet [ft]), additional TC’s shall be provided as described herein. The maximum DC resistance per cable pair shall be no more than 28.6 Ohms per 305 M (1,000 feet). Each TC shall be centrally located to cover the maximum amount of local floor space. The TC’s house in cabinets or enclosures, on relay racks, and/or on backboards, various telecommunication data equipment, controllers, multiplexers, bridges, routers, LAN hub(s), telephone cross-connecting, active and passive equipment.
 - 2) Additionally, the TC’s may house fire alarm and video equipment. Regardless of the method of installation, mounting, termination, or cross-connecting used, all backbone, vertical, and horizontal copper, and fiber optic cables shall be terminated on appropriate cross-connection systems (CCS) containing patch panel(s), punch blocks, and/or breakout devices provided in enclosures and tested as described herein. A cable and/or wire management system shall be a part of each CCS.
 - a) A minimum of three 110-120 VAC active quad outlets shall be provided, each with “U” grounded receptacles at a minimum of one outlet for each front, side and back wall. These outlets shall be separately protected by an AC circuit breaker provided in the designated Government Emergency Critical Care AC power panel, that is connected to the Facilities Emergency AC Power Distribution System. For larger building TC applications, a minimum of one additional quad AC outlet shall be provided for every 800M² (or 8,000 ft²) of useable floor space. Additional outlets shall be equally spaced along the wall.

- b) Climate control shall be provided in each TC 24 hours a day, seven days per week and 52 weeks per year to prevent failure of electronic components and for mission critical functional applications. The RE are responsible for informing the Contractor regarding the minimum climate control requirements. In identified hostile TC locations where it has been determined (by the RE) that proper TC climate or external signal radiation cannot be properly maintained or controlled, the Contractor may, at his/her option, provide a minimum of two individual and properly sized self contained climate controlled equipment cabinet enclosures; one designated for voice and one designated for data in each TC location identified on the drawings, in lieu of providing additional required TC air handling capability.
- b. 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 MTC, each IMTC, 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 MTC, each IMTC, 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 are likely to occur throughout the expected life of the system. All fiber optic cable slack shall be stored in protective enclosures.

- 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 or STP 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 to earth ground at each cable’s entry point in and out of the MTC and each IMTC.
- c. Main Cross-connection Subsystem (MCCS): The MCCS shall be located in the MTC and it shall be the common point of appearance for inter and intra-building copper and fiber optic “backbone” system cables, and connections to the telephone and data cable systems. The MTC usually houses telephone EPBX, public address, radio paging interface, routers, and main hierarchical data LAN concentrating equipment. Additionally, it shall provide a single administration and management point for the entire System.
- d. 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 Category 6 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) All system “inputs” from the EPBX, FTS, Local Telephone System, or diverse routed voice distribution systems shall appear on the “left” side of the IDC (110A blocks with RJ45 connections are acceptable alternates to the IDC) of the MCCS.
- 7) All system “outputs” from the MCCS to the voice backbone cable distribution system shall appear on the “right” side of the same IDC (or 110A blocks) of the MCCS.
- 8) 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.
- 9) UTP or STP cross connecting wires shall be provided for each “pair” of connection terminals plus an additional 50% spare.

- e. Data Cross-Connection Subsystems:
- 1) The MCCC 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.

- f. Fiber optic Cross-Connection Subsystems: The MTC shall be provided with a separate fiber MCCC. 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). 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 “ST” female connector terminated with a fiber optic cable, shall be used. But, if the fiber optic cable is not used (or “dark”), a “ST” male terminating “cap” shall be provided for each unused “ST” female connector.

- g. Intermediate Cross-connection Subsystems (IMCCS): The MTC and each IMTC shall be provided with an IMCCS that shall be the connection point between the MCCA 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 MCCA paragraphs.
- h. Distribution Cable Systems / Backbone Cable System (Common to Inter-buildings): The backbone cable system extends from the MCCA 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 MCCA 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 MCCA 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 M CCS via the BC distribution system shall appear on the “top” row of jacks of the appropriate patch panel of the IM CCS.
 - 8) All data system “outputs” or trunk line connections shall appear on the “bottom” row of jacks in the same patch panel of the IM CCS.
 - 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 “Buss” Topology with separate dedicated fibers between the M CCS and each IM CCS. The System shall be sized to meet the system requirements plus an expansion capability of 50%. Fiber optic cable(s) having a minimum of 24 strands multimode fiber and 12 strands single mode fiber shall be provided.
 - 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 IM CCS and each Riser TC’s provided vertical cross-connecting system (V CCS) within a building. The media (copper, fiber optic, etc.) 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 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 “Buss” 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 24 strands multimode fiber and/or 12 strands single mode fiber shall be provided.
- 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.

- j. 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 (copper, fiber optic, etc.) 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 CCS system shall be provided as a part of the System.
- 1) The UTP, STP, and fiber optic 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 or STP data cable.
 - c) On the “top” row of “ST” connectors on the appropriate patch panel for each fiber cable.
 - 2) The UTP, STP, and fiber optic sub-trunk (lateral) floor 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 (or 110A block) 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) On the “bottom” row of “ST” connectors on the appropriate patch panel used as the VCCS input for each fiber cable.
 - d) The technical requirements of the VCCS and HCCS “patch”, “terminating”, or “breakout” panels and cable management assemblies for voice, data and fiber optic (and RF coaxial) 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.

- k. Horizontal (or Station) Cabling (HC): The HC distribution cabling system 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 or STP conductors that are rated for Category 6 telecommunications service for voice and data systems.
 - 2) The number of UTP or STP 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 (or 110A block) 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.
- l. 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, and one each fiber optic single mode and multimode cables and shall process and distribute them to the designated TCO’s and as shown on the drawings. TCO’s shall be associated with an active 120 VAC shall be provided and as shown on the drawings.
 - 1) Each TCO shall consist of four (4) multipin modular RJ45 jacks, two designated for telephone (voice) 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 “punch down” 110A block or approved IDC 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 RJ45/11 jacks 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 and STP RJ45 connector and its pin assignments.

B. System Performance:

1. 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) \pm 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 \pm 0.1 dBmV.
 - d) System speed: 120 mBps, minimum.
 - e) System data error: 10 to the -8 Bps, minimum.

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 of 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.

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. The Telephone Contractor is responsible for providing interfacing cable connections for the telephone systems with the System.
5. Active electronic component equipment shall consist of solid state components, be rated for continuous duty service, comply with the requirements of FCC standards for telephone equipment, systems, and service.
6. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications.
7. All interconnecting twisted pair, fiber-optic or coaxial cables shall be terminated on equipment terminal boards, punch blocks, breakout boxes, splice blocks, and unused equipment ports/taps shall be terminated according to the OEM's instructions for telephone cable systems without adapters. The Contractor shall not leave unused or spare twisted pair wire, fiber-optic, or coaxial cable unterminated, unconnected, loose or unsecured.
8. Color code all distribution wiring to conform to the Telephone Industry standard, EIA/TIA, and this document, whichever 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. Reference Section 27 10 00, STRUCTURED CABLING and Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT - EXTENSION.
9. Connect the System's primary input AC power to the Facility's Critical Branch of the Emergency AC power distribution system as shown on the plans or if not shown on the plans consult with RE regarding a suitable circuit location prior to bidding.

10. Plug-in connectors shall be provided to connect all equipment, except coaxial cables and interface points. Coaxial cable distribution points and RF transmission lines shall use coaxial cable connections recommended by the cable OEM and approved by the System OEM. Base-band cable systems shall utilize barrier terminal screw type connectors, at a minimum. Crimp type connectors installed with a ratchet type installation tool are and acceptable alternate as long as the cable dress, pairs, shielding, grounding, and connections and labeling are provided the same as the barrier terminal strip connectors. Tape of any type, wire nuts, or solder type connections are unacceptable and will not be approved.
11. All equipment faceplates utilized in the System shall be stainless steel, anodized aluminum, or UL approved cyclac plastic for the areas where provided.
12. Noise filters and surge protectors shall be provided for each equipment interface cabinet, switch equipment cabinet, control console, local, and remote active equipment locations to ensure protection from input primary AC power surges and noise glitches are not induced into low Voltage data circuits.
13. Underground warning tape shall be standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable, red with black letters imprinted with "CAUTION BURIED ELECTRIC LINE BELOW", orange with black letters imprinted with "CAUTION BURIED TELEPHONE LINE BELOW" or orange with black letters imprinted with "CAUTION BURIED FIBER OPTIC LINE BELOW", as applicable.

D. Equipment Functional Characteristics:

FUNCTIONS	CHARACTERISTICS
Input Voltage	105 to 130 VAC
Power Line Frequency	60 Hz \pm 2.0 Hz
Operating Temperature	0 to 50 degrees (°) Centigrade (C)
Humidity	80 percent (%) minimum rating

E. Equipment Standards and Testing:

1. The System has been defined herein as connected to systems identified as Critical Care performing Life Support Functions. Therefore, at a minimum, the system shall conform to all aforementioned National and/or Local Life Safety Codes (which ever are the more stringent), NFPA, NEC, this specification, JCAHCO Life Safety Accreditation requirements, and the OEM recommendations, instructions, and guidelines.

2. All supplies and materials shall be listed, labeled or certified by UL or a nationally recognized testing laboratory where such standards have been established for the supplies, materials or equipment. See paragraph minimum requirements Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, and the guidelines listed in paragraph 2.J.2.
3. The provided active and passive equipment required by the System design and approved technical submittal must conform with each UL standard in effect for the equipment, as of the date of the technical submittal (or the date when the RE approved system equipment necessary to be replaced) was technically reviewed and approved by VA. Where a UL standard is in existence for equipment to be used in completion of this contract, the equipment must bear the approved UL seal.
4. Each item of electronic equipment to be provided under this contract must bear the approved UL seal or the seal of the testing laboratory that warrants the equipment has been tested in accordance with, and conforms to the specified standards.

2.2 DISTRIBUTION EQUIPMENT AND SYSTEMS

A. Telecommunication Outlet (TCO):

1. The TCO shall consist of two (2) telephone multipin jack and two (2) data multipin jacks mounted in a steel outlet box.
2. All telephone multipin connections shall be RJ-45/11 compatible female types. All data multipin connections shall be RJ-45 female types.
3. 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.
4. 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.
5. The wall outlet shall be provided with a stainless steel or approve alternate cover plate to fit the telephone multipin jack, 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, underground 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:

- a. The System cable shall be provided by the Contractor to meet the minimum system requirements of Category 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 6
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
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

3. Data Multi-Conductor:

- a. The cable shall be multi-conductor, shielded or unshielded cable with stranded conductors. The cable shall be able to handle the power and voltage used over the distance required. It shall meet Category 6 service at a minimum.
- 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
Overall Outside (if OEM specified)	100%
Individual Pairs (if OEM specified)	100%
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

4. Fiber Optic:

- 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.

2) Technical Characteristics:

Bend radius	6.0", minimum Outer jacket, As required
Fiber diameter	62.5 microns
Cladding	125 microns
850 nM	4.0 dB per kM, maximum
1,300 nM	2.0 dB per kM, maximum
850 nM	160 mHz, minimum
1,300 nM	500 mHz, minimum
Connectors	Stainless steel

b. Single mode Fiber:

- 1) The general purpose single mode 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.

2) Technical Characteristics:

Bend radius	100 mm (4 in.) minimum
Outer jacket	PVC
Fiber diameter	8.7 microns
Cladding	125 microns
Attenuation at 850 nM	1.0 dBm per km
Connectors	Stainless Steel

5. AC Power Cable: AC power cable(s) shall be 3-conductor, no. 12 AWG minimum, and rated for 13A-125V and 1,625W. Master AC power, installation specification and requirements, are given in the NEC and herein.

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	Voice Grade
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 Category 6
Connector	RJ-45 male on each end
Color coding	Required, data industry standard
Size	24 AWG, minimum

D. System Connectors:

1. Solderless (Forked Connector):

- a. The connector shall have a crimp-on coupling for quick connect/disconnect of wires or cables. The crimp-on connector shall be designed to fit the wire or cable furnished. The connector barrel shall be insulated and color-coded.

b. Technical Characteristics:

Impedance	As required
Working Voltage	500 V

2. Multipin:

- a. The connector shall have a crimp-on coupling for quick connect/disconnect of wires or cables. The crimp-on connector shall be designed to fit the wire or cable furnished. The connector housing shall be fully enclosed and shielded. It shall be secured to the cable group by screw type compression sleeves.

b. Technical Characteristics:

Impedance	As required
Working Voltage	500 V
Number of pins	As requires, usually 25 pairs minimum

3. Modular (RJ-45/11 and 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 and STP cables.

a. Technical Characteristics:

Type	Number of Pins
RJ-11/45	Compatible with RJ45
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 μ A, maximum
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

3. Fiber Optic:

- 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 fiber optic cable.

b. Technical Characteristics:

Frequency	Lightwave
Power blocking	As required
Return loss	25 dB
Connectors	"ST", minimum
Construction	Stainless steel
Impedance	As required

F. 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 (i.e. Ericsson, 3M, etc.), 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. The MDF/telephone closet riser cable shall be sized to satisfy all voice requirements plus not less than 50% spare (growth) capacity in each telephone closet which includes a fiber optic backbone. The MDF/telephone closet riser cable shall be sized to satisfy all voice and data requirements plus not less than 50% spare (growth) capacity in each telephone closet which does not include a fiber optic backbone.
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

2.3 TELECOMMUNICATIONS CLOSET REQUIREMENTS

- A. Refer to VA Handbook H-088C3, Telephone System Requirements, 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.

2.4 ENVIRONMENTAL REQUIREMENTS: 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:

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

2.5 INSTALLATION KIT: 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:

- A. 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.
- B. 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.
- C. 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.
- D. 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.
- E. 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.
- F. 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.
- G. 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 vertical and horizontal copper and fiber optic, and coaxial cables shall be terminated so any future changes only requires modifications of the existing 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 coaxial cables carrying telephone and data 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 19 mm (3/4 in.).
- 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 Articles 517 for Critical Care and 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, its 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.
- g. Ensure that Critical Care Systems (as identified by NEC Section 517) are completely separated and protected from all other systems.

2. Signal Duct, Cable Duct, or Cable Tray:

- a. The Contractor shall use existing signal duct, cable duct, and/or cable tray, when identified and approved by the RE.
- b. Approved signal and/or cable duct shall be a minimum size of 100 mm x 100 mm (4 in. X 4 in.) inside diameter with removable tops or sides, as appropriate. Protective sleeves, guides or barriers are required on all sharp corners, openings, anchors, bolts or screw ends, junction, interface and connection points.

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.
 - b. Fiber optic cables that are spare, unused or dark shall be provided with Industry Standard “ST” type female connectors installed in appropriate break out, patch, or bulkhead connector panels provided in enclosure(s) and shall be protected from the environment.
 - c. Coaxial cables that are spare, unused or dark shall be provided with the cable OEM specified type female connectors installed in appropriate break out, patch, or bulkhead connector panels provided in enclosure(s) and shall be protected from the environment.
 - d. All cable junctions and taps shall be accessible. Provide an 8” X 8” X 4” (minimum) junction box attached to the cable duct or raceway for installation of distribution system passive equipment. Ensure all equipment and tap junctions are accessible.
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 its 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 prevent 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 penetrate 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.

- 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 cyclac 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. Grounding:

1. General: The Contractor shall ground all Contractor Installed Equipment and identified Government Furnished Equipment to eliminate all shock hazards and to minimize, to the maximum extent possible, all ground loops, common mode returns, noise pickup, crosstalk, etc. The total ground resistance shall be 0.1 Ohm or less.
 - a. The Contractor shall install lightning arrestors and grounding in accordance with the NFPA and this specification.
 - b. Gas protection devices shall be provided on all circuits and cable pairs serving building distribution frames located in buildings other than the building in which the MDF is located or in any area served by an unprotected distribution system (manhole, aerial, etc.). The Contractor shall install the gas protection devices at the nearest point of entrance in buildings where protection is required and on the same circuits on the MDF in the telephone switch room.
 - c. Under no conditions shall the AC neutral, either in a power panel or in a receptacle outlet, be used for system control, subcarrier or audio reference ground.

- d. The use of conduit, signal duct or cable trays as system or electrical ground is not acceptable and will not be permitted. These items may be used only for the dissipation of internally generated static charges (not to be confused with externally generated lightning) that may be applied or generated outside the mechanical and/or physical confines of the System to earth ground. The discovery of improper system grounding shall be grounds to declare the System unacceptable and the termination of all system acceptance testing.
2. Cabinet Buss: A common ground buss of at least #10 AWG solid copper wire shall extend throughout each equipment cabinet and be connected to the system ground. Provide a separate isolated ground connection from each equipment cabinet ground buss to the system ground. Do not tie equipment ground busses together.
3. Equipment: Equipment shall be bonded to the cabinet bus with copper braid equivalent to at least #12 AWG. Self grounding equipment enclosures, racks or cabinets, that provide OEM certified functional ground connections through physical contact with installed equipment, are acceptable alternates.
4. Cable Shields: Cable shields shall be bonded to the cabinet ground buss with #12 AWG minimum stranded copper wire at only one end of the cable run. Cable shields shall be insulated from each other, faceplates, equipment racks, consoles, enclosures or cabinets; except, at the system common ground point. Coaxial and audio cables, shall have one ground connection at the source; in all cases, cable shield ground connections shall be kept to a minimum.
- I. 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. Conduit, Cable Duct, and/or Cable Tray: The Contractor shall label all conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 meters (10 ft.) identifying it as the System. In addition, each enclosure shall be labeled according to this standard.

4. 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".

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 T568B pin assignments and cabling connections are in compliance with ANSI/EIA/TIA standards. Visually confirm Category 6 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 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 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 and/or STP and backbone 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.
 2. Multimode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with ANSI/EIA/TIA-568-B.3 and ANSI/EIA/TIA-526-14A using Method A, Optical Power Meter and Light Source or Method B, OTDR. Perform verification acceptance test.

3. Single mode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with ANSI/EIA/TIA-568-B.3 and ANSI/EIA/TIA-526-7 using Method A, Optical Power Meter and Light Source and/or Method B, OTDR. Perform verification acceptance test.
- E. Performance Testing:
1. Perform Category 6 tests in accordance with ANSI/EIA/TIA-568-B.1 and ANSI/EIA/TIA-568-B.2. Test shall include the following: wire map, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, propagation delay and delay skew.
 2. Fiber Optic Links: Perform end-to-end fiber optic cable link tests in accordance with ANSI/EIA/TIA-568-B.3.
- F. Total System Acceptance Test: The Contractor shall perform verification tests for UTP and/or STP copper cabling system(s) and the multimode and single mode fiber optic 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.

3.3 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.

3.4 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 possession 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. 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) 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 in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) 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 31 31
VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT - EXTENSION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installing, certification, testing, and guaranty of a complete and operating extension of an existing operating Telephone System, and associated equipment (here-in-after referred to as "*the System*") and associated equipment to be installed in the Substance Abuse Building and the Consolidated Patient Care Services Building here-in-after referred to as "*the Facility*". The System shall include, but not be limited to, equipment cabinets, interface enclosures, and relay racks, stand-by battery(s), necessary combiners, traps, and filters; distribution nodes and/or amplifiers; telephone instruments; auxiliary systems; and necessary passive devices such as: protectors, isolators, splitters, couplers, cable "patch", "punch down", and cross-connector blocks or devices, cable management items, voice and digital cable distribution system, and associated hardware. The System shall additionally include, but not be limited to: telecommunication closets (TC); telecommunications outlets (TCO); copper and fiber optic distribution cables, connectors, "patch" cables, and/or "break out" devices.
- B. The System shall be delivered free of engineering, manufacturing, installation, and operating defects. It shall be designed, engineered and installed for ease of operation, maintenance, and testing.
- C. The term "provide", as used herein, shall be defined as: designed, engineered, furnished, installed, certified, and tested, by the Contractor.
- D. The Telephone System is defined as an Emergency Critical Care Communication System by the National Fire Protection Association (NFPA). Therefore, if 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.

- E. 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.

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Section 27 10 00, STRUCTURED CABLING.
- E. Section 26 27 26, WIRING DEVICES.
- F. Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- G. Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- H. Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
- I. H-088C3, VA HANDBOOK DESIGN FOR TELEPHONE SYSTEMS

1.3 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project's sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute's Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.4 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. Joint Commission on Accreditation of Health Care Organization (JCAHO): Comprehensive Accreditation Manual for Hospitals - Volumes One and Two.
- C. National and/or Government Life Safety Code(s): The more stringent of each listed code.

- D. National Fire Protection Association (NFPA):
 - 70-11National Electrical Code (NEC)
 - 75Protection of Electronic Computer/Data Processing Equipment
 - 77Recommended Practice on Static Electricity
 -Standard for Health Care Facilities
 - 101Life Safety Code
 - 1221Emergency Services Communication Systems
- E. Underwriter’s Laboratories, Inc. (UL):
 - 65Wired Cabinets
 - 96Lightning Protection Components
 - 96A.....Installation Requirements for Lightning Protection Systems
 - 467Grounding and Bonding Equipment
 - 497/497A/497B.....Protectors for Paired Conductors/Communications Circuits/Data
Communications and Fire Alarm Circuits
 - 884Underfloor Raceways and Fittings
- F. ANSI/EIA/TIA PUBLICATIONS:
 - 568B.....Commercial Building Telecommunications Wiring Standard
 - 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
 - 758Grounding and Bonding Requirements for Telecommunications
in Commercial Buildings
- G. Lucent Technologies: Document 900-200-318 “Outside Plant Engineering Handbook”.
- H. International Telecommunication Union – Telecommunication Standardization Sector (ITU-T).
- I. Federal Information Processing Standards (FIPS) Publications.
- J. Federal Communications Commission (FCC) Publication: Standards for telephone equipment and systems.
- K. United States Air Force: Technical Order 33K-I-100 - Test Measurement and Diagnostic Equipment (TMDE) Interval Reference Guide.

1.5 QUALITY ASSURANCE

- A. The authorized representative of the System's 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 regard to coordinating, engineering, testing, certifying, supervising, training, and documentation. Each of these installations shall have been in successful operation for a minimum of three years after final acceptance by the user. These installations shall be provided as a part of the submittal 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, and physical support for the System. This documentation, along with the System Contractor and OEM certifications must be provided in writing as a part of the Contractor's Technical Submittal.
- D. 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.

1.6 SUBMITTALS

- A. On-Site Survey: The Contractor shall provide an on-site telephone equipment location, cable pathway, TC, TCO, and interconnection survey with the submittal that is accomplished no later than 18 months prior to the expected completion of the facility.
 - 1. The survey will be accomplished by a physical walk through of the facility and existing locations with the contract drawings (including all approved changes) and existing survey performed by the IRM department. Differences in locations between the two surveys shall be clearly identified and shall be provided to the RE in writing within 30 days of the completion of the survey.
- B. Provide submittals in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. The 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 indicating the areas where the submittal deviated from the System Specifications. The RE shall retain one copy for Official Records.
- C. Documents: The submittal shall be separated into sections for each subsystem and shall contain the following:
1. Title page to include:
 - a. VA 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 (3) 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 numbers (including fax).
 - 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 as it is expected to be installed.
 4. A list of equipment to be furnished. The quantity, make and model number of each item is required. Select the required equipment items quantities that will satisfy the needs of the System and edit as needed. Delete equipment items that are not required, add additional items required, and renumber section as per system design. List format shall be as follows:

The following is the minimum equipment required by the System:

QUANTITY	UNIT
As required	CSU
As required	Back-up Battery Power Supply
As required	AC Power Supply
As required	Equipment Cabinet(s)
As required	Environmental Cabinet
1 ea.	Lightning Protection System
As required	Distribution/Interface Cabinets
As required	Stand Alone Relay Rack

As required	CCS
As required	Audio Alarm Panel
As required	Trouble Annunciator Panel
As required	Wire Management System/Equipment
As required	Telephone Instruments
As required	Cable Distribution System
As required	System Conduits, Cable Duct, and/or Cable Tray
1 ea.	Installation Kit
1 ea.	Separate Spare Part List
As required	Telephone Paging Adapter (one each required for PA, Radio Paging and sub-systems)
As required	Time Out Device (one each required for PA, Radio, and Dial Dictation sub-system)

5. Interface cabinet and each distribution cabinet layout drawing, as each is to be installed.
 6. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
 7. Engineering drawings of the System, showing calculated signal levels at the CSU output, each input and output distribution point, proposed telephone outlet values, and signal level at each telephone outlet multipin jack.
 8. List of test equipment as per paragraph 1.5.E below.
 9. A letter certifying that the Contractor understands the requirements of the Samples paragraph 1.5.F below.
 10. A letter certifying that the Contractor understands the requirements of Section 3.2 concerning acceptance tests.
- D. Environmental Requirements: Technical submittals shall confirm the environmental specifications for TC areas occupied by 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 Contractor shall identify the ambient temperature and relative humidity operating ranges required to prevent 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. Main backbone, trunk line, riser, and horizontal cable pathways, cable duct, and conduit requirements between each MTC, TC, and TCO.
- E. Test Equipment List. 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 an accuracy better than the parameters to be tested. The test equipment furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 3 months prior to the test. As part of the proposal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:
1. Spectrum Analyzer.
 2. Signal Level Meter.
 3. Volt-Ohm Meter.
 4. Time Domain Reflectometer (TDR) with strip chart recorder.
 5. Bit Error Test Set (BERT).
- F. Samples. A sample of each of the following items shall be furnished to the RE for approval prior to installation. The samples may be returned to the Contractor at the discretion of the RE.
1. TCO Wall Outlet Box 100 mm x 100 mm x 63 mm (4" x 4"x 2.5") with:
 - a. Two (2) telephone (or voice) RJ45 jack installed.
 - b. Two (2) multi pin data RJ45 jacks installed.
 - c. Cover Plate installed.
 2. Data CCS patch panel, punch block or connection device with RJ 45 connectors installed.
 3. Telephone CCS system with IDC and/or RJ45 connectors and cable terminal equipment installed.
 4. Fiber optic CCS patch panel or breakout box with cable management equipment and "ST" connectors installed.
 5. 610 mm (2 ft.) section of each copper cable to be used with cable sweep tags as specified in Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING, and connectors installed.

6. 610 mm (2 ft.) section of each fiber optic cable to be used with cable sweep tags as specified in Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING, and connectors installed.

G. 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 Local (whichever is the more stringent) 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 paragraph 3.2.B.

H. Equipment Manuals: Ten (10) working days prior to the scheduled acceptance test, the Contractor shall deliver four (4) 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.

I. As-Installed Equipment and Wiring Diagrams. Fifteen (15) working days prior to the scheduled 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. The drawings shall show the signal levels of the telephone aural carriers of each telephone channel at the input and output of all electronic equipment, beginning and end of each distribution line, and the telephone outlets. The record wiring diagrams shall be provided in hard copy and two compact disk copies properly formatted to match the Facilities current operating version of Computer Aided Drafting (AUTO CAD) system. The RE shall verify and inform the Contractor of the current version of AutoCAD being used by the Facility. The RE shall submit one hard copy of each as-installed drawing to TSSO-005N2 for review 15 working days prior to the scheduled acceptance test.

- J. Ten (10) days prior to the start of the intermediate test, provide a typewritten detailed description of the System testing plan that meets this specification's performance standards as indicated in paragraph 2.1.C including illustrations and utilizes test equipment specified in paragraph 1.5.C. The test plan will need to be evaluated and approved by the RE before intermediate testing begins.
- K. Provide two copies of an OEM developed training video tape presentation (reference paragraph 3.3.B) for evaluation and approval by the RE.
- L. Provide a typewritten document that details the complete record program in memory for all associated station assignments.
- M. Needs Analysis (required for extension of existing system): The Contractor shall conduct a needs analysis of the existing Facility with representative's from the IRM and various departments to determine the System's requirements. The analysis shall depict System features and capacities, in addition to specific site requirements. The analysis shall be typewritten and contain the following information as a minimum:
1. The CSU shall be compatible with the existing or projected EPBX and will:
 - a. Initially provide:

EQUIPPED ITEM	CAPACITY	WIRED CAPACITY
Main Station Lines:		
a) Single Line		
b) Multi Line (Equipped for DID)		
Two-way DRTL		
Foreign Exchange (FX)		
WATS		
Conference		
Dial Dictation Access		
RADIO PAGING ACCESS		
AUDIO PAGING ACCESS		
Off-Premise Extensions		
CO Trunk By-Pass		
CO Trunk By-Pass		
CRT w/keyboard		
Printers		

Operator Consoles		
T-1 Access Equipment		
Maintenance Console		

- b. Projected Maximum Growth. The Contractor shall identify the projected maximum growth for each item identified in Paragraph 1.5.C.4 as a part of the needs analysis. For this purpose, the following definitions are provided to detail the System's capability:
- 1) All software and hardware required to completely equip the CSU with all items listed under equipped capacity, shall be provided and installed by the contractor 30 days prior to system cut-over.
 - 2) "Wired Capacity" is to include all wiring and equipment listed under wired capacity, with the exception of line, data, and trunk cards, and shall be provided, installed, and tested 30 days prior to system cut-over.
 - 3) The System shall be capable of expansion to the projected maximum growth through the use of printed circuit boards and/or modular cabinets which do not require extensive re-wiring and reprogramming.
2. Cable Distribution System: A design plan for twisted pair and fiber-optic distribution cable plant requirements is not included in this document. See Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING, for specific cable distribution system requirements. However, the Contractor is required to formulate a projected cable count that shall coincide with the Maximum Growth items described herein. It is the Contractors responsibility to provide the systems CCS, cable distribution, and TCO requirements in order to develop a copper and fiber-optic distribution requirements plan using the following paragraphs as an example:
- a. Twisted Pair Requirements/Column Explanation:

Column	Explanation
From Building	Identifies the building by number or title
Floor	IDENTIFIES THE FLOOR BY NUMBER (I.E. 1ST, 2ND, ETC.)
Room Number	Identifies the room, by number, from which cabling shall be installed
Number of Cable Pair	Identifies the number of cable pair required to be terminated on the floor designated or the number of cable pair (VA Owned) to be retained
Building	Identifies the building by number or title
Room	Identifies room number

b. Fiber Optic Cabling Requirements/Column Explanation:

Column	Explanation
From Building	Identifies building, by number or location, from which cabling is installed
Room Number	Identifies the room, by number, from which cabling shall be installed
To Building	Identifies building, by number or location, to which cabling is installed
Room Number	Identifies the room, by number, to 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 requirements as designated herein
Notes	Identifies a note number for a special feature or equipment
Building	Identifies the building by number or title

3. Telephone Instruments (or Stations). The Contractor shall clearly and fully indicate this category for each telephone instrument and compare the total count to the locations identified above and indicated the projected EPBX port count requirements as a part of the technical submittal. Additionally, the Contractor shall indicate the total number of spares:

Column	Explanation
MSL	Number of Main Station Lines (MSL) to be associated with the instrument.
Instrument and Outlets. All equipment to be installed are assigned the following codes:	
DS	Desk type - single line
WS	Wall type - single line
DM	Desk type - multi-line
WM	Wall type - multi-line
Jack	The type of jack shall be the type identified (i.e. wall, single, dual, triplex, etc.).
Notes	Identifies a note number which spells out a requirement for a special feature or function associated with the circuits and equipment on that particular line of the station.
SVC	Identifies the using SERVICE.
Position	Identifies primary user of the instrument by position description or function.

4. Telecommunication Outlets (TCO). The Contractor shall clearly and fully indicate this category for each outlet location and compare the total count to the locations identified and as shown on the drawings 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 extend the following minimum services generated by the existing telephone system. If these services are not generated by an operating existing telephone system, the System shall be fully compatible and capable of providing them 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 service. The System shall be capacity sized so that loss of connectivity to an external telephone system(s) shall not affect the Facilities operation in specific designated emergency operating locations and instruments. The System shall:
 - a. Inter-operate, connect, and function 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), at a minimum.
 - b. Inter operate with current identified voice mail and automatic attendant functions, and are required as specified herein. A universal night answering function from a Facility designated remote locations shall be provided if not currently in operation and/or will not be deviated as a result of the system installation.
 - c. Be a voice and data cable distribution system that is based on a physical “Star” and/or “Bus” Topology.

- d. 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 radio paging, audio paging, Federal Information Processing Standards [FIPPS] publications), Industry Standard "T" and/or "DS" carrier protocols 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. Additionally T-1 access/equipment (or CSU) shall be used in FTS and other trunk applications as required by system design if these functions are not provided by the existing telephone system and/or will be deactivated by the System. The Contractor shall provide all T-1 equipment necessary to terminate and make operational the quantity of circuits designated. The CSU's shall be connected to the system's emergency battery power supply. The System shall be fully capable of operating in the Industry Standard "DS" protocol and provide that service when required.
- e. Contain attendant and operator consoles, video monitors with keyboards, and printers to provide employee directory access from the Traffic Management System (TMS), as required by system design if not provided by the existing telephone system and/or will be deactivated by the System installation. All additional console positions, video monitors, and keyboards shall have identical capabilities. The System shall accept a mixture of trunk types at each attendant console and extend calls received via these trunks to station users.
- f. Be capable of interfacing and operating with Direct-Incoming-dial (DID) service to stations as identified herein. Assignment to DID shall not affect intra-Facility operation. A DID trunk group, which will operate as a separate trunk group from other Central Office (CO) trunks shall be provided as described herein.
- g. Contain the designated number of telephone instruments, where each instrument (also referred to as "station") shall have the ability to direct dial other Facility telephone stations, the public telephone network, tie-lines, and FTS telephone numbers without attendant assistance. Each station shall be dual tone multi-frequency (DTMF) for intra-Facility and external-Facility calling. The term DTMF, as used herein, shall be defined as "a dialing operation (e.g., push-button, digit dialing, or tone dialing, other than rotary/pulse dialing).
 - 1) Standard digital telephone instruments shall be provided as directed by the Owner.
 - 2) "Special hands free" digital telephone instruments shall be provided as directed by the owner.

- h. Receive the specified telephone signals acquired from the LEC and FTS contracted carrier, shall process and distribute them to the designated telephone stations as determined by Class-of-Service and indicated on the drawings.
- i. Each TCO shall be supplied with an associated (within 305 mm (one foot)) or attached active duplex 120 Volts Alternating Current (VAC) outlet (using a quad receptacle box for the TCO and a separate duplex receptacle box for the AC outlet) and as shown on the drawings.
 - 1) The Contractor shall provide the TCOs that consist of two (2) telephone multipin and two (2) data multipin jacks each meeting Category 6 Level of service. The telephone multipin jack shall be interfaced and connected to the System via a terminal punch block in each associated TC.
 - 2) The telephone system Contractor shall connect each data multipin jack to a separate data system approved terminating patch panel device in each associated TC. The telephone system Contractor is not to install active data distribution equipment to the System or cross connect the data systems.
 - 3) The construction of distribution of TCOs is found in Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
 - 4) The appropriate distribution cable termination methods are found in Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
 - 5) The appropriate distribution TC construction is found in Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
- j. Be able to accomplish adjacent channel operation of the existing telephone system's local, long distance, and FTS telephone signals. The System equipment shall be installed and interfaced according to the OEM's schematic diagram for adjacent telephone channel operation. The System shall be provided with testing capability in each equipment rack and test ports that provide access for each telephone channel without the need to disconnect distribution cables or equipment. Each telephone channel shall be processed as a single channel. A means of monitoring the complete system along with appropriate printout and computer disk archiving of each processed and distributed channel.

- k. The System shall be designed to minimize cross talk, background processor noise, inter-modulation and other signal interference. The equipment shall be installed and interfaced according to the OEM schematic diagram for adjacent audio channel operation. Each audio input channel shall be processed as a single separate channel and combined into one output channel. Additionally, if not provided in the existing telephone system or will be deactivated by the System installation, an audio, and visual monitoring panel shall be provided in the telephone switch room to test each converted audio input and distribution channel transmitted and received signal functions as described herein. The System shall continuously electronically or electrically supervise the EPBX's Alternating Current (AC) power input, stand by batteries and charger, and internal Direct Current (DC) power supply primary Voltages and/or Currents. If a trouble panel has not already been provided in the existing MCR, provide a trouble panel to check the supervisory signals, signal level, audio sound and visual level, and alert personnel to problems as described herein.
- 2. Refer to Section 1.5 for initial voice sizing requirements.
- 3. The System shall be capable of interfacing with the existing or future planned EPBX.
- 4. A system design where "looping" the distribution cables from room to room shall not be permitted. See Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING, for cable distribution TC and TCO requirements.
- 5. Point of Telephone System Interface:
 - a. The telephone signals shall be acquired at the existing telephone EPBX equipment cabinet or as designated in the telephone switch room TC. The Contractor is not responsible for the condition of the telephone signals of the existing telephone system. If the telephone signals at the interface point do not meet the minimum signal level and quality as stated herein, the Contractor shall notify the RE, in writing, detailing the nature of the deficiencies, and the expected effect on the telephone signals in the new extension system. The RE will coordinate with the Facility Engineering Officer so the necessary repairs for the identified deficiencies can be accomplished.
 - b. The System shall acquire telephone signals at the EPBX.
 - c. A minimum of 10 emergency telephone connections shall be acquired at the EPBX and connected to 10 back up circuits as shown on the drawings.

B. General:

1. All equipment to be supplied under this specification shall be new and the current model of a standard product of an OEM of 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 factory production line for the item submitted.
 - b. Maintains a stock of replacement parts for the item submitted.
 - c. Maintains engineering drawings, specifications, and operating manuals for the items submitted.
 - d. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least one year 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 for which there is a specification contained herein, the item shall meet or exceed the specification for that item of equipment.
3. The Contractor shall produce verification, in writing to the RE at time of installation, that the type of wire/cable actually being provided is recommended and approved by the OEM and will provide a total system free of undesirable effects. The Contractor is responsible for providing the correct protection cable duct and/or conduit and wiring even though the actual installation may be by another subcontractor.
4. The Telephone Contractor is responsible for interfacing the telephone systems with the System. The Contractor shall continually employ interfacing methods that are approved by the OEM and VA. At a minimum, an acceptable interfacing method, requires not only a physical and mechanical connection; but, includes matching of signal, voltage, and processing levels, with regard to signal quality and impedance. Each interface point must adhere to all standards described herein for full separation of the Critical Care, Life Safety, and Emergency systems.
5. Active electronic component equipment shall consist of solid state components, be rated for continuous duty service, comply with the FCC standards for telephone equipment, systems, and service.
6. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications.

7. All interconnecting twisted pair, fiber optic or coaxial cables shall be terminated on equipment terminal boards, punch blocks, breakout boxes, splice blocks, and unused equipment ports/taps shall be terminated according to the OEM's instructions for telephone cable systems without adapters. The Contractor shall not leave unused or spare twisted pair wire, fiber optic, or coaxial cable unterminated, unconnected, loose or unsecured.
8. The System shall utilize microprocessor components for all signaling and programming circuits and functions. Program memory shall be non-volatile or protected from erasure from power outages for a minimum of two hours.
9. The System shall provide the continuous electrical supervision of each telephone switch cabinet mounted equipment, interconnecting cabling, distribution cable plant, and back up battery and charger to determine change of status and to assist in trouble shooting System faults.
10. All distribution Voltages, except for the primary AC power to the power supply circuits, shall not exceed 30V AC Root Mean Squared (RMS) or 42V direct current (DC).
11. Color code all distribution wiring to conform to the Telephone Industry standard, ANSI/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 wiring diagrams, to facilitate installation and maintenance. Reference Section 27 10 00, STRUCTURED CABLING and Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
12. Connect the System's primary input AC power to the Facility' Critical Branch of the Emergency AC Power Distribution System as shown on the Drawings or if not shown on the drawings consult with the RE regarding a suitable circuit location, prior to bidding.
13. Verify existing UPS system will support the extensions additional load. If adequate capacity is not present, provide the additional equipment required to support the normal operation and functions of the System including the extension (as if there was no AC power failure) in the event of an AC power failure for a minimum of four hours.
14. All equipment shall function and operate normally from the furnished power source, and also, during input power fluctuations or loss of power for a minimum of four hours.

15. Plug-in connectors shall be provided to connect all equipment, with the exception of interface points. Baseband cable systems shall utilize barrier terminal screw type connectors, at a minimum. Crimp type connectors installed with a ratchet type installation tool are and acceptable alternate as long as the cable dress, pairs, shielding, grounding, connections and labeling are provided the same as the barrier terminal strip connectors. Tape of any type, wire nuts, or solder type connections are unacceptable and will not be approved.
16. All equipment faceplates utilized in the System shall be stainless steel, anodized aluminum, or UL approved cycolac plastic that matches the equipment item where it is installed. All faceplates shall be constructed of the same material throughout the Facility.
17. Noise filters and surge protectors shall be provided for each equipment interface cabinet, switch equipment cabinet, control console, local, and remote active equipment locations to ensure protection from input primary AC power surges and noise glitches are not induced into low voltage circuits.

C. Equipment Functional Characteristics:

FUNCTIONS	CHARACTERISTICS
Input Voltage	105 to 130 VAC
Power Line Frequency	60 Hz \pm 2.0 Hz
Operating Temperature	0 to 50 degrees (°) Centigrade (C)
Humidity	80 percent (%) minimum rating

2.2 EQUIPMENT SPECIFICATIONS

A. Customer Service Unit (CSU) Equipment:

1. The CSU shall be fully self contained, electronic, digital in operation, fully compatible with the existing telephone equipment, EPBX, and perform, as a minimum, the following functions:
 - a. Intra-Facility: station-to-station four digit direct dialing, including those telephone instruments equipped with the DID features.
 - b. Direct-output-dial (DOD): from any unrestricted telephone instrument to any CO trunk or FTS access lines by dialing a pre-designated access code. Also, DOD from any station to tie-lines by dialing a pre-designated access code.
 - c. Incoming calls from FTS: access lines and tie-lines shall have the ability to direct dial all stations without attendant assistance.
 - d. Restricted telephone instruments: shall have access to outside lines through the operators' console.

- e. Unrestricted telephone instruments: shall have access to all features, functions, CO trunks, FTS access lines, tie-lines, toll free 800 numbers, and long distance directory assistance.
- f. Class-of-service (COS): restrictions provided by the existing telephone system shall be provided. These restrictions are to be applied individually or in combination as dictated by individual telephone number service requirements. Technical submittals shall describe the number and type of COS restrictions available.
- g. Provide all station users with the feature package provided by the existing telephone system or at a minimum, those listed below. The ability to restrict any of these features on a station by station basis shall be provided:
 - 1) Line Hunt Capability
 - 2) Consultation Hold
 - 3) Shall Transfer
 - 4) Call Pick-Up
 - 5) Call Forwarding
 - 6) Call Queuing
 - 7) Call back/Ring back
 - 8) Music on Hold
 - 9) Conferencing
 - 10) Automatic Number Identification
 - 11) Station to Station Call Waiting
 - 12) Station and System Speed Dialing
 - 13) Call Park
 - 14) Universal Night Answer Service
 - 15) Line Load Control
 - 16) Dual Common Controls
 - 17) Line Lock Out
 - 18) Supervisory Signaling and Ringing
- h. Fusing:
 - 1) The CSU shall be equipped with fuses to protect the total telephone system and individual segments of the CSU so that a problem in one segment may be isolated without damaging the total CSU.
 - 2) Fuses shall be of the alarm indicating type and their rating designated by numerical or color code on fuse panels that are easily visible.

i. Equipment Power Supply:

- 1) The CSU shall be equipped with a complete on-line power supply. The System shall consist of AC surge protection, dual load-sharing rectifiers/chargers, batteries, and inverter.
- 2) The power supply shall have a capacity sufficient to support the CSU including its projected maximum growth and as required in this specification for interfaced equipment.
- 3) The UPS w/Battery Back-up or the reserve battery power supply shall have sufficient capacity to supply the CSU for four (4) hours including projected maximum growth and interfaced equipment. The battery power supply shall consist of not less than 24 sealed (dry cells are not acceptable), maintenance-free cells.
- 4) The system shall be capable of adjustable voltage for float or equalizing batteries. A full redundant system (not including batteries and inverter) shall be provided. Each rectifier or charger shall have the capacity to support the combined load requirements of the existing EPBX as configured including maximum growth and interfaced equipment.
- 5) The Contractor shall coordinate with the local Facility Telephone Contractor, coordinated through the RE and Facility Contracting Officer, to determine CO trunk, FTS access line, and other required interface unit power requirements and provide power to the GFE telephone company or Facility furnished and installed interface units so they will continue to function in event of a commercial AC power failure.

j. Alarms and Trouble Indicators:

- 1) The Contractor shall provide visual and audible alarms, equipped with cut-off switches, indicating AC power failure, rectifier failure, major and minor alarms, and temperature/humidity alarms. The Contractor shall be responsible for providing the required sensors for environmental alarms. These alarms shall be remoted to the existing telephone system and one other location to be as specified herein. These alarms shall be separate and in addition to the major and minor alarm functions.
- 2) The alarm panel(s) shall contain small red indicator lamps for each alarm with cut-off switches or one switch for all alarms and a distinctive audible alarm(s) that can be heard over the ambient noise in its respective location. If one cutoff switch is provided for all audible alarms, it shall restore the alarms to the ready status condition for the audible registration of additional alarms.
 - a) The technical submittal shall describe any other CSU alarms that are remoted.

- b) The technical submittal shall describe CSU alarms/indicators of malfunction(s) that are located on the equipment.
- k. The CSU shall provide four-digit intra-station dialing.
 - 1) Due to the varied trunk group requirements and possible future trunk group requirements, e.g. audio paging, alternate access codes may be proposed. Grouping of like type trunk group/features, e.g. 5-2 radio paging, 5-3 audio paging is acceptable.
 - 2) The CSU shall provide emergency numbers accessible by all station users. The numbers shall appear on the console or a multi-line instrument and at least one other designated location. There shall be a distinctive audible and visual signal associated with the emergency number to ensure immediate response to calls. The console or multi-line instrument shall have the capability of priority answering the emergency number and extending the call as the situation dictates. A modified trunk circuit may be used for this purpose.
- l. The CSU equipment shall have such sensitivity as required to provide satisfactory service up to 3,000 feet for all voice locations.
- m. The Contractor shall provide a complete set of EPBX electronic modules and/or cards to be used as on-hand operational emergency spare equipment. One each of T-1, DS-**, interface cards etc. is the minimum required or a compliment as directed by the OEM. Additionally, the Contractor shall confer with the RE to determine other spare items that may be required to equip the system with a fully emergency repair capability completely adhering to the System Guaranty Requirements as described herein.
- 2. The installed CSU shall be as a minimum, compatible with the existing EBPX or equipped with the following features at a minimum:
 - a. AC to DC power supplies.
 - b. Emergency battery power supply.
 - c. DC to AC inverter power supply (shall be connected to the CSU emergency battery power supply).
 - d. Dual common controls.
 - e. Redundant signaling supply units, or equivalent.
 - f. Cable distribution frame.
 - g. Cable distribution system.
 - h. Programmable Emergency Telephone Number(s).

- i. An on-site automatic program loading device (tape drives are not acceptable) to reload system memory in case of power or system failure (shall be connected to the CSU emergency battery power supply).
 - j. An on-site maintenance administration terminal (MAT) with CRT/keyboard and printer (shall be connected to the CSU emergency battery power supply).
 - k. An automatic central office trunk connection to pre-determined stations for emergency trunk by-pass/cut-through service. Immediately upon failure of the GFE EPBX, these stations shall have the ability to process calls. If required, each of these stations shall be equipped with automatic ground start for outgoing calls. Single line instruments, if required, shall be provided by the contractor.
3. Voice Mail:
- a. The system shall allow a predetermined number of users to send complete and confidential messages in the users own voice and receive complete and confidential messages in the sender's own voice. The system shall provide 24 hours per day, 7 days per week access. The system shall be integrated into the operation of the existing telephone system and be compatible with the local telephone company central office.
 - b. The system shall provide capacity for the following number of ports:

	Equipped Capacity	Wired Capacity
Automated Attendant	12	20
Voice Mail	12	20
 - c. The voice mail system shall initially provide for 500 mailboxes and 40 hours of storage with growth to 60 hours of storage.
 - d. Voice Mail Features. The system shall have the following features:
 - 1) Access to the system and its features from any instrument anywhere that provides DTMF signaling.
 - 2) The ability of those leaving a message to review the message and/or edit the message that is being placed in the mailbox.
 - 3) Privacy/Security through the use of a "password".
 - 4) The ability to send messages to users on the voice mail system in the following manner:
 - a) To any user on the same voice mail system.

- b) To more than one user on the same voice mail system - an ad hoc distribution list determined by the sender at the time of message transmission.
 - c) To a predetermined distribution list.
 - d) Broadcast to all users on the same voice mail system.
- 5) Verification, with Receipt: The ability of a user to request and receive verification of when a message is actually played through the use of a touch-tone command. The system shall indicate the time and date of when a message is played and place that information in the sender's mailbox.
 - 6) Envelope Information: The ability of a user to request and receive time and date information of when specific messages were left in the user's mailbox.
 - 7) Connection to the voice mail system shall be through an extension number of the existing telephone system EPBX or a seven/ten digit telephone number from the LEC.
 - 8) Message "PROMPTS" shall be provided for every transaction. Messages shall be provided for "GREETINGS" and "INSTRUCTIONS FOR RECORDING OR EDITING A MESSAGE".
 - 9) A message waiting tone, lamp, and/or display shall notify the user that messages are in the user's mailbox.
 - 10) A message shall notify the user, upon accessing the system, of how many messages are in the user mailbox.
 - 11) The user, upon accessing the system, shall have the following response alternatives:
 - a) Respond or send a reply to another user on the same voice mail system.
 - b) Route the message to another user on the same voice mail system.
 - c) Delete the message.
 - d) Save the message.
 - 12) A "Default Path" shall be provided to allow those callers who do not have touch-tone capability or who need to talk to someone to be routed to an operator or some other predetermined answering position.
 - 13) The system shall the ability to fast forward or rewind-recorded messages while being reviewed by the user.
 - 14) The system shall present messages to the user on a "FIFO" basis.
 - 15) User Administration: The system shall provide, as a minimum, management information and statistics in the following categories:
 - 16) Port Usage: Traffic statistics on each of the different access paths into the system.

- 17) Usage of Storage Capacity - Remaining storage capacity at any one time and during peak periods.
- 18) Mailbox Usage: Connect time and number of new or saved messages.
- 19) The user administration terminal shall allow for "Class of Service Controls" in the following areas and for the following parameters:
 - a) Initial Authorization:
 - (1) Ability to enable a mailbox.
 - (2) Record the "OWNER'S" name.
 - (3) Set initial PASS NUMBER.
 - b) Usage Control:
 - (1) Length of personal greeting.
 - (2) Length of messages received.
 - (3) Number of messages.
 - (4) Message retention time.
 - c) Feature Authorizations - Allowed or Not:
 - (1) Group List Creation.
 - (2) Group List Usage.
 - (3) Broadcast Messages.

B. Voice Traffic Management System (TMS):

1. A complete and self-contained on-site TMS shall be provided that is fully compatible with and compliments the existing telephone system.
2. As a minimum, the following functions shall be provided:
 - a. A 300 characters per second (CPS) letter quality printer, shall be provided. The CSU and/or the maintenance administration terminal may generate some of the reports.
 - b. The TMS shall be connected to the CSU emergency battery power supply.
 - c. All screen menus shall be standard with access to each category of reports to be provided.
 - d. Traffic Accounting and Management Call Detail Recording (CDR) Package shall be provided for all voice circuits. The TMS shall:
 - 1) Include all necessary hardware, software, and interconnections to the CSU.
 - 2) Contain a database that shall be stored on non-volatile media. Tape drives are not acceptable.
 - 3) Contain line numbers, physical locations of equipment by building and room number, the department to which a line is assigned, the name of the person(s) assigned to a particular number, the type of equipment, and any comments regarding CSU features.

- 4) Support additional I/O ports for video monitors or other terminals, which will allow a passive display of the data base(s) by, authorized medical center personnel other than those individuals responsible for data input and conducting studies.
 - 5) Exhibit a method of security that shall be provided by User ID and password to protect the data base(s).
 - 6) Perform separate voice line reports, on demand and predetermined schedule, for automatic printing. As a minimum, the following reports are required:
 - a) Originating trunk traffic by trunk group expressed in CCS.
 - b) Terminating trunk traffic by trunk group expressed in CCS.
 - c) All trunk busy, by trunk group, expressed as blocked call count.
 - d) All equipment busy, i.e., no dial tone and failure to complete cross office call because of all equipment busy, expressed in blocked call count.
 - e) List of all equipment alarms, error tables, trouble logs, history files, V & H coordinates etc.
 - 7) Perform the following console measurements for each console:
 - a) Incoming calls.
 - b) Calls answered.
 - 8) Contain remote video monitors that shall be provided in the immediate vicinity of the telephone operators for use as an on-line directory lookup system of Facility personnel. The Contractor provided monitors shall be compatible with the proposed TMS hardware and software.
 - 9) Produce reports that shall be in English notation and will not require interpretation of abbreviations or codes by the user.
 - 10) Contain sufficient storage on disk shall be provided to prevent a purge of stored data. Call record and facility usage data shall be maintained in the database for a minimum of 30 days. Storage must be capable of accommodating a minimum of 5,000 calls per day.
- e. Samples of all reports generated by the TMS are to be submitted with the technical submittal for evaluation of formats and compliance with information field content.
 - f. Detailed description of the method to be used to measure traffic data shall be included in the technical submittal.

- g. Normal system traffic data shall be furnished to the appropriate Facility staff within seven days of a Facility request. A complete and comprehensive traffic study, to include the required traffic data with the Contractor's comments and recommendations, will be prepared and submitted to the appropriate Facility staff quarterly. These studies shall be provided at no additional cost to the VA.
 - h. Automatic directory service shall generate a telephone directory that includes, name, title, organization, location, extension, and class-of-service. The contractor shall be responsible for loading and maintaining the directory.
 - i. A Cable plant management function shall be provided with the following requirements, at a minimum:
 - 1) A list of off-premise cable by circuit number, numbers of pairs for each circuit, and circuit definition.
 - 2) Provide a complete cable plant distribution record to identify the location (cable pair) on the MDF, the riser, the size cable, cable pair in-use (main cable feeder and station cable), building and room number of the termination, and the type equipment terminated.
 - 3) Automatically provide when the service order is entered, the cable number and pair assignments.
 - j. Equipment inventory list shall be provided containing the following minimum requirements:
 - 1) CSU cabinets, cards (active and spares), batteries, current and surge protectors, rectifiers, all peripheral equipment, i.e. radio page, audio page, etc.
 - 2) Quantity of single and multi-line telephones, speakerphones, dial intercom units, speakers, gongs, loud horns, bells, chimes, recorders, etc.
 - 3) A list of equipment as being used or spare; ordered or received; installed date, warranty date, cost, location, serial number, etc.
- C. Equipment Cabinet with Internal Mounting Rack:
- 1. The equipment cabinet shall be lockable, heavy gauge steel with baked on paint finish. It shall be floor or wall mounted with knock-out holes for cable entrance and conduit connection, provided with ventilation ports and quiet fan with non disposable air filter for equipment cooling. Two keys shall be provided for each lock to the RE when the System is accepted.

2. A minimum of one cabinet shall be provided with blank rack space, for additional equipment. Blank panels shall be installed to cover any open or unused rack space. Two 120 VAC power strips connected to surge protectors, cooling fan with non-disposable air filter, and conduit or cable duct interface to adjacent cabinet(s) shall be a part of this cabinet.
3. Blank panels shall be color matched to the cabinet, 3.175 mm (1/8") aluminum with vertical dimensions in increments of 44 mm (1.75") with mounting holes spaced to correspond to Electronic Industry Association (EIA) 480 mm (19") dimensions. Single standard size blank panels shall be used to fill unused panel or rack spaces in lieu of numerous 44 mm (1.75") types. One blank 44 mm (1.75") high blank panel shall be installed between each item of equipment.
4. AC Power Outlet Strip(s):
 - a. A strip shall be provided with an outlet for each item of equipment and a minimum of four spare AC power outlets. Each strip shall be mounted inside and at the rear of each equipment cabinet. It shall contain "U" ground AC outlets for distributing AC power to the installed electronic equipment. The strip shall be self-contained in a metal enclosure with a maximum of 1.8 M (6-foot) connecting wire with three-prong plug.

b. Technical Characteristics:

Power capacity	20 Ampere (AMP), 120 VAC continuous duty
Wire gauge	Three conductor, #12 AWG copper

5. Cabinet AC Power Line Surge Protector and Filter:
 - a. Each cabinet containing active electronic equipment shall be equipped with a AC Surge Protector and Filter. The Protector and Filter shall be housed in one single enclosure. The Protector and Filter shall provide instantaneous regulation of the AC input voltage and isolate and filter any noise present on the AC input line. It shall be cabinet mounted and the cabinet AC power strip (two strips maximum) may be connected to it.

b. Technical Characteristics:

Input Voltage range	120 VAC + 15%
Power capacity	20 AMP, 120 VAC
Voltage output regulation	+3.0%
Circuit breaker	15 AMP, may be self contain
Noise filtering	Greater than 45 dB
AC outlets	Four duplex grounded types, minimum

Response time	5 Nano Seconds
Surge suppression	10,000 AMPS
Common	-40 dB
Differential	-45 dB

6. Main AC Input Line:

- a. The CSU shall be equipped with AC voltage and current surge protectors to prevent damage to the CSU and rectifiers from power line induced voltage spikes, surges, lightning, etc.
- b. Specific requirements for current and surge protection shall include:
 - 1) Five nanosecond (ns) response time to the transient.
 - 2) Voltage protection threshold, line to neutral, starts at no more than 220 volts peak. The transient voltage shall not exceed 300 volts peak. Vendor shall furnish documentation on peak clamping voltage as a function of transient AMP.
 - 3) Peak power dissipation is 35 joules per phase (minimum), as measured for 1 millisecond at sub branch panels, 100 joules per phase at branch panels and 300 joules per phase at service entrance panels. Vendor shall furnish an explanation of how the ratings were measured or empirically derived.
 - 4) Surge protector must not short circuit the AC power line at any time:
 - a) The primary surge protection components must be silicon semiconductors. Secondary stages, if used, may include other types of devices.
 - b) Surge protectors shall incorporate a visual device which indicates whether the surge suppression component(s) is (are) functioning.
 - c) Surge protection devices shall be UL listed.
 - d) Voltage and current surge protectors shall be provided on all ancillary equipment provided by the Contractor, not powered from the CSU primary power supply and emergency battery, e.g., electronic telephones, service units, custom telephones, speaker phones, modems, data terminal interface, etc.
 - e) Power dissipation 12,000 Watts (W) for 1 millisecond (12 Joules).
 - f) Voltage protection threshold starts at not more than 110 VAC.
 - g) Surge protectors must not short-circuit the A/C line at any time.
 - h) Surge protectors shall be wholly self contained, plug in type for 110/120 VAC, 15 AMP, duplex receptacle.

D. Stand Alone Equipment (Or Sometimes Called Radio Relay) Rack:

1. If provided, 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 floor or wall mounted or mounted on casters as directed by the RE.
2. Technical Characteristics:

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

E. 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 inch) 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 (or Telephone):
 - 1) The CSS for voice or telephone service shall be Industry Standard 110 type punch blocks. This represents the minimum requirement for voice or telephone, and control wiring in lieu of patch panels, each being certified for category 6 service. IDC punch blocks (with internal RJ45 jacks) are acceptable for use in all CCS and shall be specifically designed for category 6 telecommunications service and the size and type of UTP cable used as described herein. As a minimum, punch block strips shall be secured to an OEM designed physical anchoring unit located on a wall in the MTC, IMTC, and TC. However, console, cabinet, rail, panel, etc. mounting is allowed at the OEM's recommendation and as approved by the RE. Punch blocks shall not be used for Class II or 120 VAC power wiring.

2) Technical Characteristics:

Number of horizontal rows	100, minimum
Number of terminals per row	4, minimum
Terminal protector	required for each used or unused terminal
INSULATION SPLICING	required between each row of terminals

b. Fiber Optic:

- 1) Product reference of a Government Approved (US State Department) type is Telewire, PUP-17 with prepunched chassis mounting holes arranged in two horizontal rows. This panel may be used for fiber optic, audio, control cable, and Class II Low Voltage Wiring installations when provided with the proper connectors. This panel is not allowed to be used for 120 VAC power connections.

2) Technical Characteristics:

Height	Two RUs, 89 mm (3.5") minimum
Width	484 mm (19-1/16"), EIA minimum
Number of connections	12 pairs, minimum
Connectors:	"ST"
Control Signal Service	Barrier strips surface mounted with spade lugs (punch block or wire wrap type strips are acceptable alternates for barrier strips as long as system design is maintained)
Low voltage power (class II)	Barrier strips with spade lugs and clear full length plastic cover, surfaced mounted
Fiber optic	"ST" Stainless steel, female

c. Mounting Strips and Blocks:

1) Barrier Strips:

- a) 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.

b) 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

- 2) 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.
- 3) Punch Blocks: Industry Standard 110 type punch blocks are approved for data, voice, and control wiring at a minimum. 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.
- 4) Wire Wrap Strips: Wire wrap strips (minimum of 1.65 mm (0.065") wire wrap) are approved for voice and control wiring and shall meet Industry Standards. Wire wrap strips shall be secured to a cabinet, rail, panel, etc. Wire wrap strips shall not be used for Class II or 120VAC power wiring.

F. 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 TC 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 frame in 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.

G. Telephone Instruments:

1. Telephone instruments (or station equipment) that are initially installed shall be configured as indicated herein. Final location of some station equipment shall be coordinated with designated VA official prior to installation.
2. All telephone instruments shall be equipped with the inductive capability to radiate a magnetic field required to activate the hearing aid telecoil and to provide personnel, who use hearing aids, access to all telephones within the Facility.
3. Station equipment shall consist of standard single line instruments, patient bedside instruments, and multi-line digital electronic telephone instruments with digital display, of the latest state-of-the-art design.
4. All telephone instruments except patient bedside phones, shall be equipped with a flash button (or equivalent feature button) with pre-determined timing feature to initiate consultation hold and other features normally initiated by operation of the hook-switch. Flash button shall be distinct from the hook-switch.
5. All telephone instruments, except patient bedside phones, shall be equipped with a laminated faceplate listing the most common user features and their appropriate access codes. The faceplates may be an integral part of the instrument housing or may be an adhesive backed decal that shall be applied over the tone pad area of the housing at the time of telephone set installation.
6. Station instruments shall be feature compatible and have transmission characteristics which are compatible with the proposed system.

7. Telephone instrument signaling shall be by means of standard adjustable, buzzers, chimes, or electronic tone, unless otherwise specified:
 - a. Single Line:
 - 1) Single line instruments may be electronic or 2500-type analog phones.
 - 2) Single line instruments used must be capable of supporting bridged cabling to allow a single phone number on multiple instruments without using multiple switch ports.
 - 3) Single line instruments must be capable of supporting auxiliary equipment, such as amplified handsets; external chimes, light, or bells; and other similar equipment without using multiple switch ports.
 - b. Multi-Line, Digital and Electronic:
 - 1) The instruments shall be equipped with a digital read-out display and shall have no less than 14 programmable (lines or features) buttons.
 - 2) The instruments shall employ only one adjustable ringer, bell, buzzer, chime or electronic tone to announce calls. The signaling device shall detect an incoming call to the multi-button instrument and provide an audible signal only on designated lines.
 - 3) Each instrument shall be equipped with lights to identify the called line and remain illuminated for the duration of the call.
 - 4) Telephone intercom systems shall normally be associated with these instruments.
 - 5) The equipment associated with intercom systems may require special features such as built in microphone and speaker. Telephone Intercom Systems shall be required to provide secretaries with a means of announcing calls to offices with extensions or pickups on the system. The provision of intercom systems shall be identified during the data base survey required as described herein. Any required intercom systems shall be provided and installed by the contractor.
 - 6) This equipment must be capable of supporting auxiliary equipment, such as amplified handsets; external chimes, light, or bells; and other similar equipment. The use of analog switch ports to provide ringing voltage, if required, is acceptable and these switch ports shall be included in the Equipped Capacity as described herein.
 - 7) Hot Line Telephones shall be provided between two identified points and as shown on the drawings. These hot lines shall be equipped with two-way automatic ring and cut-off controlled by the telephone hook-switch, i.e. when near-end hand set is removed from the hook switch, the far-end telephone shall ring until the hand set is removed from the hook-switch.

- 8) Hands Free telephone stations shall be required. In this configuration, a speaker shall be used as both transmitter and receiver to answer or initiate a call. These facilities will normally be used as a hot line between two points. Requirements for hands-free operated facilities shall be identified on the drawings.

2.3 DISTRIBUTION EQUIPMENT AND SYSTEMS

- A. The System shall be provided with a complete cable backbone and building distribution system consisting of copper, fiberoptic, and other specified cable and connectors, signal closets, cross connection or terminating systems, telecommunication outlets and interface points as identified in Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING and with technical instructions and approval from the RE.

2.4 INSTALLATION KIT

The kit provided shall include, at a minimum, 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. The Contractor shall turn over all unused and partially opened installation kit boxes, coaxial, fiber-optic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware to the RE. At a minimum, the following installation sub-kits are required:

- A. 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. Cable Duct.
 - h. Cable Trays.
 - i. Power Panels.

- j. Connector Panels.
- k. Grounding Blocks.
- B. 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.
- C. 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.
- D. 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.
- E. 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, Record Wiring Diagrams, and this document.
- F. 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 model and serial identification numbers. The RE may inventory the EPBX and related equipment.
 - 2. Storage and Handling: Store and protect equipment in a manner that will preclude damage as directed by the RE.
- B. System Installation:
 - 1. After award of contract, 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, which complies with, accepted industry standards of good practice, the requirements of this specification and in a manner that 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, telephone outlets, and pads for minimizing interference and for balancing the amplifiers and distribution system(s). Items used for balancing and minimizing interference shall be able to pass telephone channels in the frequency bands selected, in the directions specified, with low loss, and high isolation and with minimum 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 correct termination, isolation, impedance match and signal level balance at each telephone outlet.
5. Where telephone/data outlets 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 vertical and horizontal copper and fiber optic lines shall be terminated so shall require modifications of the System CSU 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 cables carrying digital signals in telephone 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. Equipment Assembly:

1. Cabinets:
 - a. Each enclosure shall be: Floor or wall mounted with standard knockout holes for conduit connection or cable entrance; provide for ventilation of the equipment; have front and rear locking doors (except, wall mounted cabinets that require only a front locking door); power outlet strip(s), connector, and patch panel(s).

- b. Each enclosure shall be equipped with a quiet fan and nondisposable air filter.
- c. Enclosures and stand alone racks shall be installed plumb and square. Each shall be permanently attached to the building structure and be held firmly in place and approved by the RE.
- d. Rack mounted equipment shall be installed in the enclosure's equipment adjustable mounting racks with equipment normally requiring adjustment or observation mounted so operational adjustment(s) can be conveniently made. Heavy equipment shall be mounted with rack slides or rails allowing servicing from the front of the enclosure. Heavy equipment shall not depend only upon front panel mounting screws for support. Equipment shall be provided with sufficient cable slack to permit servicing by removal of the installed equipment from the front of the enclosure. A color matched blank panel (spacer) of 44 mm (1.75 inches) high, shall be installed between each piece of equipment (active or passive) to insure adequate air circulation. The enclosure shall be designed for efficient equipment cooling and air ventilation.
- e. Provide 380 mm (15 inches) of front vertical space opening for additional equipment. Install color matched blank panels to cover any unused enclosure openings.
- f. Signal connector, patch, and connector panels (i.e. telephone, TV, etc.) shall be connected so that outputs from each source, device or system component shall enter the panel at the top row of jacks, beginning left to right as viewed from the front. These will be called "inputs". Each connection to a load, device or system component shall exit the panel at the bottom row of jacks, beginning left to right as viewed from the front. These will be called "outputs".
 - 1) Equipment located indoors shall be installed in metal racks or enclosures with hinged doors and be accessible for maintenance without interference to other nearby equipment.
 - 2) Cables shall enter the equipment racks or enclosures in such a manner that allows all doors or access panels to open and close without disturbing or damaging the cables.
 - 3) All distribution hardware shall be securely mounted in a manner that allows access to the connections for testing and provides sufficient room for the doors or access panels to open and close without disturbing the cables.

2. Installation of the CSU:

a. General:

- 1) The CSU installation shall comply with all laws and codes applying to interconnected telephone installations.
- 2) In the absence of specifications regarding installation details, standard industry practices shall prevail and first quality material and workmanship shall be provided.
- 3) All material, installed by the Contractor, shall be new and thoroughly tested. All installation shall be carried out in a professional manner.
- 4) Installation of all equipment shall be fully coordinated with the RE and Facility staffs. No area shall be left without minimal telephone service as described herein.
- 5) The Contractor shall provide an outlet with four (4) modular jacks with stainless steel cover plate for each telephone outlet as shown and verified on the drawings. The Contractor shall provide the appropriate modular jack(s) with appropriate cover plate for each 'outlet' location identified on the drawings.
- 6) The Contractor shall install all patient and wall telephone instruments on a single modular jack designed for wall telephone instruments and patient wall or PBPU installations.
- 7) All permanent telephone cable and wire shall be installed in conduit or an enclosed duct system or be of the type approved for installation, as determined by VA requirements, without conduit or enclosed duct system. Cable and wire not installed in conduit or an enclosed duct system must be installed in cable tray or mechanically supported and separated from other signal cable systems as described herein.
- 8) Where cable and wire penetrate through fire/smoke partitions, firewalls, or floors, the Contractor shall provide fire/smoke stopping around the outside of any installed conduit/cable tray. The Contractor shall provide and install fire stopping material, type approved by the RE, inside the provided conduit/cable tray after installation is complete.

b. The Contractor Shall:

- 1) Install the equipment in accordance with the specifications for the CSU as specified and recommended by the OEM.

- 2) Provide a full time on-site Project Manager effective with VA issuance of the notice to proceed. The Project Manager shall be responsible for fully coordinating and supervising all contractor/sub-contractor personnel in all phases of the installation, training, inspection, cutover, and final acceptance of the System. The Project Manager shall be provided a complete copy of these specifications to include all amendments prior to the start of installation of the telephone system.
- 3) Coordinate and conduct the CSU data base survey with the RE and a member of the IRM staff. The Contractor is responsible for identifying all programming of features, classes of service, and equipment to be installed by types and physical locations as specified in this document and all attachments thereto. After the survey is completed, a complete list of equipment shall be provided to the RE and the IRM for approval prior to the start of installation.
- 4) Be responsible for the removal and replacement of damaged ceiling tiles during installation and maintenance service of the cable and wire distribution system. The Contractor shall be responsible for restoring to original condition any immediate (approximately one meter (three feet) in diameter) areas that were damaged during the installation and maintenance of the systems.
- 5) Run all cross connects to established circuits during installation and maintenance service for the contract life.
- 6) Remove, on a daily basis, all debris and scrap generated in the conduct of work.
- 7) Provide the RE, for review, coordination and approval, a Proof of Performance Test Plan 90 days prior to activation of the CSU. The plan shall be used for testing and acceptance of the System. It shall include sufficient tests to demonstrate the systems capabilities of providing the services outlined in this document. Test equipment required for demonstration shall be Contractor provided and approved by the RE. A list of test equipment required shall be included with the acceptance test plan. Test equipment shall have undergone calibration certification within six months prior to system activation.
- 8) Provide Contractor personnel (switch technicians, installers, trainers, and the project manager) on premise for seven consecutive days after cut-over to clear any malfunctions which may develop, to assign/reassign any software features/COS, and conduct any additional training as required.

- 9) Ensure that the project manager and sufficient skilled personnel remain on premise until all items on the punch list, developed during inspection, cut-over, and acceptance testing of the System are completed, inspected, and accepted by the RE.
- 10) Be responsible for any and all coordination with the LEC relative to interface with the commercial telephone system. The contractor shall also be responsible for the removal of all voice and/or data equipment and cabling abandoned by the LEC, VA, or other organizations and not retained for exclusive use by VA as a result of this installation.
- 11) Connect all telephone equipment located in the equipment room to the common signal ground buss that is provided. The common signal ground buss shall be located in all telephone closets and the CSU switch room.
- 12) Provide system ground between CSU and all interfaced systems such as existing telephone system, etc.
- 13) Ensure that other dedicated telecommunications systems applications within the Facility (i.e., pay stations, electro-writing equipment, facsimile etc.) that require space within switch room/telephone closets, conduits, and cable pair are accommodated. Coordination between applicable parties will be necessary to ensure accommodation of these systems. It shall be the responsibility of the bidders to determine the requirements and include them in their proposal.
- 14) All portions of the System installation shall conform to local building and fire codes.
- 15) The Contractor shall not use gasoline, benzene, alcohol, naphtha, carbon tetrachloride, or turpentine for cleaning any part of the equipment. Flammable materials shall be kept in suitable places outside the building. OSHA safety standards and local Facility safety standards shall prevail.

D. Conduit, Cables and Wiring, Cable Tray, Raceways, Signal Ducts, Etc.:

1. The Contractor shall employ the latest installation practices and materials.
2. All cables shall be installed in conduit and/or signal ducts. Conduits shall be provided in accordance with Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
3. Ensure that Telephone Systems (as identified by NEC Section 517) are completely separated and protected from all systems.

4. All cable junctions and taps shall be accessible. Do not install multi-taps or other distribution equipment items inside cable ducts or raceways. As a minimum, use a 200 mm x 200 mm x 100 mm (8" X 8" X 4") junction box attached to the cable duct or raceway for installation of distribution system passive equipment. Ensure all equipment and tap junctions are accessible.
5. 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.
6. 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 wiring diagrams.
7. Cable shall be grouped and shall not change position throughout the cable run.
8. Completely test all of the cables after installation and replace any defective cables.

3.2 TEST: If this Section is being used in conjunction with Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT - EXTENSION or Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING, the following testing guidelines are in addition to the requirements outlined in these documents. If this document is being used as a "Stand Alone" cable plant installation, the following testing guidelines shall be the standard of measure for the respective system.

A. Interim Inspection:

1. The interim inspection will be conducted in the presence of a Government Representative designated as the VA Contract Coordinator prior to the proof of performance testing. This inspection shall verify that the equipment provided adheres to the installation requirements of this document.
2. The Contractor shall have 50% of the telephone extension system equipment installed to include, but not be limited to: CSU, interface, origination and junction enclosures powered with the permanent AC wiring, outlets, conduit and cables, before the interim inspection can take place.
3. The Contractor shall notify the RE, in writing, of the estimated date the Contractor expects to be ready for in the interim inspection, at least 7 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 the Contractor to continue with the System installation.

5. The RE in conjunction with PE 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 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 wiring diagrams documentation.
- B. Pretesting: Upon completing the installation of the System, the Contractor shall align and balance the system. The Contractor shall pretest the entire system.
- C. Pretesting Procedure: 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 document. The Contractor shall measure and record the aural carrier levels of each system telephone, at each of the following points in the system:
 1. Local Telephone System Inputs.
 2. CSU inputs and outputs.
 3. MDU, BIU, amplifiers, channel processor and converter inputs and outputs.
 4. CSU output S/NR for each telephone 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.
 6. A copy of the recorded system pretest measurements shall be submitted, along with the pretest certification, to the RE.
- D. Pretesting Certification. After pretesting the System, the Contractor shall notify the RE, in writing, that the System is ready for proof of performance testing, and that it meets all requirements stated in this document. The Contractor shall accomplish submission of this notification of system readiness, no later than 20 working days prior to the beginning of the scheduled Government proof of performance test. Failure of the Contractor to comply with these pretest requirements, shall be grounds for canceling the scheduled test.

E. Acceptance Test:

1. After the System has been pretested and the Contractor has submitted the pretest results and certification to the RE, the Contractor shall schedule an acceptance test date and give the RE 20 days advance 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 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 complies with the operational and technical 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 four (4) hours, shall be cause for terminating the acceptance test of the System. Repeated failures that result in a cumulative time of eight (8) hours to affect repairs shall cause the entire System to be declared unacceptable. Re-testing of the entire System shall be rescheduled at the convenience of the Government.

F. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:
 - a. The 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, Auto CAD disks, interim inspection 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: After the Physical and Mechanical Inspection, the Contractor shall perform an operational test to verify that all equipment is properly connected, interfaced and is functionally operational to meet the requirements of this specification. If any sub-system is not functionally ready, that sub-system shall be declared unacceptable and all testing shall be terminated. At this point, the Contractor shall be permitted one hour to correct the deficiencies. It may be mutually agreed upon, at this time, to wait one hour or to commence testing of the next sub-system.
3. Performance Test: After the functional test, each sub-system shall be checked to verify that all performance requirements and standards are met. The performance requirements shall be verified using the necessary test equipment. A spectrum analyzer, signal level meter and BERT shall be used to verify there are no visible signal distortions, such as inter-modulation, beats, etc. appearing on any received or generated telephone channel.
4. Total System Test:
 - a. The testing shall proceed until the system and subsystems are functionally tested and accepted. The total system tests shall verify that the requirements have been met for all system signals as described herein.
 - 1) Existing Telephone System Point of Demarcation: The system output(s) shall be checked to verify that all performance requirements are met.
 - 2) CSU: This test shall be conducted within 30 days following successful pre-testing of the CSU. In addition to compliance with the technical characteristics and quantities of equipment specified herein, the Final Acceptance Test shall contain the provision that 30 continuous days uninterrupted telephone service, must be completed prior to the Contractor being deemed to be in compliance with the contract.
 - b. For the purpose of final acceptance, the telephone service shall be considered interrupted when the failure of any Contractor provided telephone equipment including batteries, results in an interruption of service. This includes a failure of more than 20% of any trunk group, 15% of any number group (15 or more stations), operator console, or telephone service to any area determined to be critical by the Facility Director. Response time to restore service shall have no bearing upon the term "interrupted service".

- c. To facilitate the CSU Acceptance Test and to allow familiarization and training of Facility employees, the Contractor shall activate the CSU, including the operator consoles, stations and equipment a minimum of 30 days prior to the acceptance test date. All installed equipment and circuits shall be fully tested prior to the acceptance by VA. During this "burn-in" period, the Contractor shall de-bug the CSU. The Contractor shall make the CSU available for in-house communications and demonstrate to the Facility staff the required features. The Facility Director and Contractor will make designated trunks and tie-line circuits available to the CSU during this "burn-in" period for testing.
 - d. At the conclusion of the Acceptance Test, the PM, the RE and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages, if any. When the test show the System performs in accordance with the specifications, the 30 days of uninterrupted service provision shall begin. This provision must be successfully met for contract compliance. If any retests are needed to reach agreement on the results of the tests or to establish compliance with these specifications such retesting will be done at the Contractor's expense.
5. Individual Item Test: The Government Representative may select individual items of equipment for detailed proof-of-performance testing. That item shall meet or exceed the minimum requirements of the specification.
6. Distribution System:
- a. To ensure that the System meets all performance requirements, a minimum of 75% of the System outlets shall be checked. Additionally, each distribution system interface, junction and connection point or location will be checked. Each distribution active and passive item of equipment, signal input(s) and output(s) will be tested.
 - b. For specific distribution testing instructions refer to Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING, and the RE for technical assistance.

3.3 TRAINING

- A. Furnish the services of an OEM trained and certified engineer or technician for a total of two eight hour classes to instruct designated Facility maintenance personnel. Instruction shall include cross connection, corrective, and preventive maintenance of the System and equipment. Training shall be accomplished before the VA can accept the System. Additionally, training will be scheduled at the convenience of the Facility's, Chief Engineering Service.

- B. Also, furnish the services of an OEM trained and certified engineer or technician, familiar with the functions and operation of the system and equipment, for two eight hour periods to train designated Facility IRM personnel. Instructions shall be provided for staff personnel in each area where the System is installed under this contract. When multiple areas are involved, classes will be grouped. Periods of training shall be coordinated with the RE or the Facility Contracting Officer. The RE or the Facility Contracting Officer shall coordinate with the Facility to ensure all shifts receive the required training. Each session shall include instructions utilizing “hands-on” operation and functions of the System.

3.4 SYSTEM GUARANTEE

- A. Contractor’s Responsibility: 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 VA. The Contractor shall provide OEM’s equipment warranty documents, to the RE and Facility Contracting Officer, certifying that all equipment installed under this document conforms to its published specifications.
- B. The Contractor shall provide a written commitment from the System equipment OEM to the supply of parts and on-site engineering support services for the one year guarantee service (materials and labor) in the event of default or unsatisfactory service by the Contractor.
 - 1. The OEM certification shall describe, in the event of default or unsatisfactory service by the Contractor, the manufacturer or an authorized distributor shall fully support the contract (initial installation, guarantee service for the one year warranty period of the contract).
 - 2. The System equipment OEM’s signatory of the certified written commitment must be of an individual who has the full authority to obligate the OEM to this commitment. Names, corporate addresses, and telephone numbers of the individuals who have this authority shall be provided as a part of the commitment.
- C. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM's central emergency maintenance and request 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.
- D. All Contractor maintenance and supervisor personnel shall be fully qualified by the OEM and must provide two (2) copies of their current and qualified OEM training certificates and OEM certification upon request.

E. Additionally, the Contractor shall accomplish the following minimum requirements during the one year guarantee period:

1. Response Time:

- a. The RE or the 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.
- b. A standard workweek is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal Holidays.
- c. The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
 - 1) A routine trouble call within one working day of its report. A routine trouble is considered a trouble that causes a sub-system to be inoperable.
 - 2) An emergency trouble call within eight (8) hours of its report. An emergency trouble is considered a trouble that causes a system to be inoperable at anytime.
 - a) An emergency trouble call shall be deemed appropriate when a failure involves more than 20 voice circuits.
 - b) In addition, the failure of a common control unit, power supply, signal generating device or attendant console shall also be deemed as an emergency maintenance call.
 - 3) A catastrophic trouble call within four (4) hours of its report. A catastrophic trouble call is considered a EPBX failure.
 - a) If an EPBX failure cannot be corrected within six (6) hours, the Contractor shall be responsible for providing an alternate CSU equipped for a minimum of 100 station lines, 10 CO trunks, 10 FTS access lines and two operator's consoles.
 - (1) This alternate system shall be operational within 12 hours (time to commence at the end of the six-hour trouble shooting period) and shall provide emergency service to critical areas as determined by the Facility Director.
 - (2) The alternate system shall be a programmable system and a pre-written compact disk program shall be provided to the Facility Contracting Officer prior to cut-over of the main telephone system.

- b) Failures affecting operation of critical emergency health care facilities (i.e. cardiac arrest teams, intensive care units, etc.) shall also be deemed catastrophic trouble calls if so determined by the Facility Director. The Facility Contracting Officer shall notify the Contractor of this type of trouble call at the direction of the Facility Director.
- 4) The Contractor shall respond on-site to installation of station or equipment requests or service within:
 - a) Eight (8) hours for emergency installations designated by the Facility Contracting Officer, and
 - b) Three working days for routine installations designated by the Facility Contracting Officer.
- 2. Required On-Site Visits During The One Year Guarantee Period:
 - a. The Contractor shall visit, on-site, for a minimum of eight hours, once every twelve (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 specification.
 - 1) The Contractor shall arrange all Facility visits with the RE or the Facility Contracting Officer prior to performing the required maintenance visits.
 - 2) The Contractor in accordance with the OEM's recommended practice and service intervals shall perform preventive maintenance during non-busy time agreed to by the RE or the Facility Contracting Officer and the Contractor.
 - 3) The preventive maintenance schedule, functions and reports shall be provided to and approved by the RE and Facility Contracting Officer.
 - 4) Provide on-site a stock of replacement spare parts and equipment, plus test equipment, as specified herein, ensuring they meet the OEM's minimum recommended spare parts stock sizing requirements for this specific system.

- b. The Contractor shall provide the RE or the 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 or the Facility Contracting Officer sample copies of these reports for review and approval at the beginning of the Acceptance Test. The following reports are the minimum required:
 - 1) The Contractor shall provide a monthly summary for all equipment and sub-systems serviced during the guarantee period to the RE or the Facility Contracting Officer by the fifth working day after the end of each month. The report shall clearly and concisely describe the service rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and systems for preventative and predictive maintenance.
 - 2) 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 to the nature and causes and the emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.
- c. The RE or the Facility Contracting Officer shall convey to the Facility Engineering Officer, two (2) copies of actual reports for evaluation.
 - 1) The RE or the Facility Contracting Officer shall ensure a copy of these reports is entered into the System's official acquisition documents.
 - 2) The Facility Chief Engineer shall ensure a copy of these reports is entered into the system's official technical as-installed documents.
- 3. Government Furnished Equipment (GFE). GFE that was accepted by the Contractor and interfaced and installed in this System shall become part of this System and included in the guarantee requirements.

- - E N D - -

SECTION 27 41 41
MASTER ANTENNA TELEVISION EQUIPMENT AND SYSTEMS - EXTENSION

PART 1 - GENERAL

1.1 SECTION SUMMARY

- A. Work covered by this document includes design, engineering, labor, material, products, guarantee, training and services for, and incidental to the complete installation of a fully operating extension of the existing NFPA listed Master Antenna Television (TV) equipment and systems as detailed herein.
- B. Work shall be complete, complete, labeled, VA Central Office (VACO) tested and 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 10 00, STRUCTURED COMMUNICATIONS SYSTEMS CABLING.
- E. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- F. Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- G. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- H. Section 27 10 00, STRUCTURED CABLING.
- I. Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
- J. Section 27 41 41, MASTER ANTENNA TELEVISION EQUIPMENT AND SYSTEMS EXTENSION.

1.3 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project's sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute's Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.4 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/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: TME, Inc.
- F. Owner: United States Department of Veterans Affairs
- G. Contractor: Radio Contractor; you; successful bidder

1.5 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) Public Law No. 100-527, Department of Veterans Affairs:
 - a) Office of Telecommunications: 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.

- d) 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.
- 4) 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.
- 5) CFR, Title 47 - Telecommunications, in addition to 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):
 - Part 73Radio Broadcast Service
 - Part 90Rules and Regulations, Appendix C
 - Form 854 ...Antenna Structure Registration
- 6) Public Law 89-670, Department of Transportation, CFR-49, Part 1, Subpart C – Federal Aviation Administration (FAA):
 - a) Standards AC 110/460-ID and AC 707/460-2E – Advisory Circulars for Constructions of Antenna Towers.
 - b) Forms 7450 and 7460-2 – Antenna Construction Registration.
- 2. National Codes:
 - a. American Institute of Architects (AIA): Guidelines for Healthcare Facilities.
 - b. American National Standards Institute/Electronic Industries Association/Telecommunications Industry Association (ANSI/EIA/TIA):
 - 568-B 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 © 2008 IEEE Medical Grade – Mission Critical –
Wireless Networks
- C62.41 Surge Voltages in Low-Voltage AC Power Circuits
- d. American Society of Mechanical Engineers (ASME):
- Standard 17.4 Guide for Emergency Personnel
- Standard 17.5 Elevator and Escalator Equipment (prohibition of installing non-
elevator equipment in Elevator Equipment Room/Mechanical
Penthouse
- e. NFPA:
- 70-11 National Electrical Code (NEC)
- 75 Protection of Electronic Computer/Data Processing Equipment
- 77 Recommended Practice on Static Electricity
- 99 Health Care Facilities
- 101 Life Safety Code
- 1221 Emergency Services Communication Systems

1.6 QUALIFICATIONS

- A. The OEM shall have had experience with three or more installations of systems of comparable size and complexity about 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.

1.7 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.

1.8 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.

1.9 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 (TVE-005OP3B – herein after referred to as 005OP3B) will not review any submittal that does not have this list.
- D. Provide 4 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) should respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).
- E. Head End and each interface distribution cabinet layout drawing, as they are to be installed.
- F. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
- G. Engineering drawings of the system, showing calculated signal levels at the Head End input and output, each input and output distribution point, and signal level at each telecommunications outlet.
- H. Antenna Signal Survey:
 - 1. The Contractor shall submit a computerized signal survey for the system radiated and receive RF signals. The survey(s) shall be made by a recognized industry source that is derived mathematically from fixed information and projects an approximation of the signal levels that can be expected at the actual site using a given antenna.
 - 2. The signal survey can usually be obtained from the OEM for the radio equipment at no charge. An on-site survey, using actual transmitting and receiving equipment of the type the Contractor has specified, is an acceptable alternate.
 - 3. The approximate longitude and latitude of the Facility along with the elevation above mean sea level can be obtained from the Resident Engineer.
 - 4. The Contractor shall record all findings on a geographic map with the Facility residing in its center and shall outline all coverage locations, radiating in a 360-degree pattern. The primary, secondary, marginal and out of range areas operation shall be depicted by different colors for each frequency of operation.

1.10 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.

1.11 WARRANTIES AND GUARANTEE

- A. The Contractor shall warrant the installation 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.

1.12 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.

1.13 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.

1.14 PROJECT CLOSEOUT

- 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. Furnish and install a complete and fully operational extension of the existing master antenna TV signal distribution system. Include all amplifiers, power supplies, cables, outlets, attenuators, antennas, and all other parts necessary for the reception and distribution of the off-the-air TV signals.
- B. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.
- C. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.
- D. Distribute cable channels to all TV outlets to permit simple connection of EIA standard television receivers.
- E. Deliver at all outlets, all monochrome and color television signals without introducing noticeable effect on picture and color fidelity or sound. System picture fidelity shall be equal to that received from the cable company and other modulated channels.
- F. Provide reception quality at each outlet equal to or better than that received in the area with individual antennas. Deliver at all television outlets a minimum +6.0 dBmv (2,000 microvolts across 75 Ohms) and maximum of +20 dBmv (20,000 microvolts) for each channel at each outlet.
- G. 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.
- H. Meet all FCC requirements regarding low radiation and/or interference of RF signal(s). The system shall be designed to prevent direct pickup of signals from the building structure.
- I. 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. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications and be provided with screw type audio connectors.
- B. All trunk, branch, and interconnecting cables and unused equipment ports or taps shall be terminated with proper terminating resistors designed for RF, audio and digital cable systems without adapters.
- C. The system shall utilize microprocessor components for all signaling and programming circuits and functions. System program memory shall be non-volatile or protected from erasure from power outages for a minimum of 30 minutes.
- D. Provide a backup battery or a UPS for the system (including each distribution cabinet/point) 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 30 minutes.
- E. Plug-in connectors shall be provided to connect all equipment, except coaxial cables and RF transmission line interface points. Coaxial cable distribution points and RF transmission lines shall use coaxial cable connections recommended by the cable OEM and approved by the system OEM. Base band cable systems shall utilize barrier terminal screw type connectors, at a minimum. As an alternate, crimp type connectors installed with a ratchet type installation tool are acceptable provided the cable dress, pairs, shielding, grounding, connections and labeling are the same as the barrier terminal strip connectors. Tape of any type, wire nuts or solder type connections are unacceptable and will not be approved.
- F. All equipment faceplates utilized in the system shall be stainless steel, anodized aluminum or UL approved cyclolac plastic for the areas where provided.
- G. Audio Level Processing: The use of telephone cable to distribute MATV signals, carrying system or sub-system AC or DC voltage is not acceptable and will not be approved. Additionally, each control location shall be provided with the equipment required to insure the system can produce its designed audio channel capacity at TV/speaker identified on the contract drawings.
- H. 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, FCC and UL Listed, and produced by OEM manufacturer of 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:
 - 1. Maintains a stock of replacement parts for the item submitted.

2. Maintains engineering drawings, specifications, and operating manuals for the items submitted.
 3. 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.
- B. Specifications contained herein as set forth in this document detail the salient operating and performance characteristics of equipment in order for VA to distinguish acceptable items of equipment from unacceptable items of equipment. When an item of equipment is offered or furnished for which there is a specification contained herein, the item of equipment offered or furnished shall meet or exceed the specification for that item of equipment.
- C. The equipment items are the salient requirements of VA to provide an acceptable system described herein.

2.4 PRODUCTS

- A. The system distribution amplifier shall have a frequency range of 49-1,000 MHz and shall accommodate a minimum of 35 channels of programming.
- B. Provide riser rated coaxial cable with a nominal characteristic impedance of 75 Ohms throughout the entire frequency spectrum utilized in this system. Each reel of cable shall be sweep-tested and return-loss tested over the entire frequency range from 50MHz to 750MHz by the manufacturer. Provide RG-6, RG-11 or fiber optic cable and devices as required to achieve the specified signal level. However, all runs over 150' in length shall be RG-11 or fiber optic cable.
- C. Line Splitters:
1. Provide low-radiation line splitters with a flat frequency response from 50MHz to 1,000MHz. Provide units of a hybrid design with a 75-ohm match on input and outputs and a VSWR no greater than 1.4:1.
 2. Two way line splitters shall have a signal loss of not more than 3.5dB at each output.
 3. Four way line splitters shall have a signal loss of not more than 7.2dB at each output.
 4. All unused splitter outputs shall be terminated with 75-Ohm terminations.
- D. TV Outlets:
1. Provisions shall be incorporated in the network to prevent 60 Hz AC or DC feedback into the distribution lines.
 2. Outlets shall be designed to cover a frequency range of 10MHz to 1,000MHz. Insertion loss shall not exceed 1.0 db at any frequency within the designated frequency range for a 17dB isolation network. Outlets shall be back-matched from 10 to 1,000MHz. Outlets shall be combination power/television type, having an F-type connector on the left-front and a duplex receptacle on the right-front. Refer to Division 26 and coordinate with Electrical Contractor.

3. The minimum isolation value between any two outlets shall be 24 db.
- E. Television Receivers shall be provided separately by the Owner.
- F. Distribution Devices:

1. Distribution Amplifier:

- a. Description: Broadband CATV quality distribution amplifier.
- b. Specifications:

Frequency Range: 49MHz to 1,000MHz.	Channel Loading: 150.
Flatness: +/- .75dB.	Gain: 32dB.
Output Level: +40dBmV.	Gain Control Range: 10dB.
Slope Control Range: 8dB.	Plug in equalizers as needed.
Attenuator options as needed.	

2. Splitters:

- a. Description: RF signal splitter.
- b. Specifications:

Frequency Range: 5MHz to 1,000MHz.	Outputs: 2, 3, 4 and 8.
Splitter Loss: less than 12 dB.	RFI Shielding: 120dB.

3. Taps:

- a. Description: Directional Coupler Type Taps.
- b. For use in Telecomm closets or accessible cable trays.
- c. Specifications:
 1. Frequency Range: 5MHz to 1,000MHz.
 2. Outputs: 2, 4 and 8.
 3. Isolation Tap Value: Varies.

4. Wallplate Bulkhead Connector and Terminators:

- a. Description: Wall plates for termination of CATV signals at television sets.
 1. Impedance: 75 Ohms.
 2. Frequency Band: SUB/VHF/CATV/UHF.

5. "F" Connectors:

- a. Coaxial cable connectors and connector inserts shall be designed to provide maximum performance with the cable to be used. Coaxial cables shall be connectorized with the Head End quality 360 degree F connectors as applicable, meeting or exceeding standard industry and the cable manufacture's specifications. All drop F-connectors shall be hex crimp type or a "Snap and Seal" type connector. Housing to housing (KS to KS) type or 90-degree type connectors shall be used where specified by the OEM.

6. Terminator:

- a. Description: 75-Ohm terminator.
- b. Specifications:

DC blocking.	Bandwidth: 50MHz-890MHz.
Return Loss: greater than 16dB.	Impedance: 75 Ohm.

7. Trunk Cable:

- a. Description: .500 inch, Semi-Rigid Coax, Riser Rated.
- b. Specifications:

1. Maximum Attenuation:

2.92 dB/100ft at 700 MHz.	3.78 dB/100ft at 1000 MHz.
Impedance: 75 Ohm	

8. RG6 Cable:

- a. Description: CATV RG6 double shielded cable CM Rated
- b. Specifications:

1. Attenuation:

1.48 dB/100ft at 50 MHz.	7.45 dB/100ft at 1000 MHz.
Impedance: 75 Ohm	

9. RG11 Cable:

- a. Description: CATV RG11 cable CM Rated
- b. Specifications:

1. Attenuation:

0.90 dB/100ft at 50 MHz.	5.04 dB/100ft at 1000 MHz.
Impedance: 75 Ohm	

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 the faceplate and the faceplate opening for the MATV backbox.
- B. Coordinate with the cabling contractor the location of MATV equipment in the Telecommunications Closets.
- C. 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.
- D. Immediately notify the Owner, General Contractor and Engineer in writing of any discrepancies.

3.3 NEEDS ASSESSMENT

- A. Provide a one-on-one meeting with the particular nursing manager of each unit affected by the installation of the extension of the existing MATV system. Review the floor plan drawing, educate the nursing manager with the functions of the equipment that is being provided and gather details specific to the individual units; coverage and priorities of calls; staffing patterns; and other pertinent details that will affect system programming and training.

3.4 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. Finishes for any exposed work such as plates, racks, panels, speakers, etc. shall be approved by the Architect, Owner and 005OP3B.
6. 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 grommets 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 and 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 Section 27 10 00, STRUCTURED COMMUNICATIONS CABLING SYSTEM, the following additional practices shall be adhered to:
1. Comply with requirements for raceways and boxes specified in Section 27 05 33, RACEWAY AND BOXES FOR COMMUNICATION SYSTEMS.
 2. Execute all wiring in strict adherence to the National Electrical Code, applicable local building codes and standard industry practices.
 3. 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 4 inches. Where Wiring of differing classifications must cross, they shall cross perpendicular to one another.
 4. 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.
 5. 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.
 6. Replace the entire length of the run of any wire or cable that is damaged or abraded during installation. There are no acceptable methods of repairing damaged or abraded wiring.
 7. Use wire pulling lubricants and pulling tensions as recommended by the OEM.
 8. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
 9. Do not use tape-based or glue-based cable anchors.
 10. Ground shields and drain wires as indicated by the drawings.
 11. 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. Employ permanent strain relief for any cable with an outside diameter of 1 inch or greater.

12. 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 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 inch (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2 inches (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2 inches (minimum) past the Heatshrink and serve as indicated below.
 9. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing 1/4 inch 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.
- E. Labeling:
1. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
 2. 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.
 3. 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.
 4. 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.
 5. Ensure each OEM supplied equipment has permanently attached/marked the appropriate UL Labels/Marks for the service the equipment is performed. 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.

3.5 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 encounter high voltage.

3.6 CUTTING 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.

3.7 FIREPROOFING

- A. Where MATV 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.

3.8 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, commonmode 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 Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATION 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/GUARANTEE/TRAINING

4.1 SYSTEM CLASSIFICATION

- A. The MATV System is FCC and NFPA listed. Therefore, the following testing and guaranty provisions are the minimum to be performed and provided by the contractor and Warranted by the OEM.

4.2 PROOF OF PERFORMANCE TESTING

- A. Intermediate Testing:
 - 1. The inspection and test will be conducted by a factory-certified contractor representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by a local 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 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 pretested:
 - 1) Antennas.
 - 2) Lightning Grounds.
 - 3) Head End.
 - 4) Local and Remote Control Units/Enunciation Panels.
 - 5) All Networked locations.
 - 6) System interface locations (i.e.PA, Auditorium Audio, etc.).
 - 7) System trouble reporting.
 - 8) UPS operation.

- 9) Primary and Emergency AC Power Requirements
- 10) Extra Auxiliary Generator Requirements.
- 3. The Contractor shall provide 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 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 FCC 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 antennas, head end terminating and control equipment shall be checked to verify that it meets all performance requirements outlined herein. A spectrum analyzer and sound level meter shall be utilized to accomplish this requirement.
 - b. Following the Antennas and Head End equipment test, the local control unit shall be connected to the Head End equipment's output test tap to ensure there are no signal distortions such as intermodulation, data noise, popping sounds, erratic system functions, on any function.
 - c. The distribution system shall be checked at each interface, junction, and distribution point, first, middle, and last leg to verify that the MATV video, audio and control signals meets all system performance standards.
 - d. Each MATV outlet shall be functionally tested at the same time utilizing the Contractor's approved hospital grade TV receiver and Spectrum Analyzer.
 - e. Once these tests have been completed, each installed sub-system function shall be tested as a unified, functioning and fully operating system.
 - f. Individual Item Test: The VACO 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 borne 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.

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 possession 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 MATV 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.
 - 4) If a MATV component failure cannot be corrected within 6 hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate MATV equipment. The alternate equipment/system shall be operational within a maximum of 18 hours after the 6 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 One Year Guarantee 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. 12 hours prior to opening
 2. 12 hours during the opening week

3. 12 hours for supervisors and system administrators

--- E N D ---

SECTION 28 05 00
COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section, Common Work Results for Electronic Safety and Security (ESS), applies to all sections of Division 28.
- B. Furnish and install fully functional electronic safety and security cabling system(s), equipment and approved accessories in accordance with the specification section(s), drawing(s), and referenced publications. Capacities and ratings of cable and other items and arrangements for the specified items are shown on each system's required Bill of Materials (BOM) and verified on the approved system drawing(s). If there is a conflict between contract's specification(s) and drawings(s), the contract's specification requirements shall prevail.
- C. The Contractor shall provide a fully functional and operating ESS, programmed, configured, documented, and tested as required herein and the respective Safety and Security System Specification(s). The Contractor shall provide calculations and analysis to support design and engineering decisions as specified in submittals. The Contractor shall provide and pay all labor, materials, and equipment, sales and gross receipts and other taxes. The Contractor shall secure and pay for plan check fees, permits, other fees, and licenses necessary for the execution of work as applicable for the project. Give required notices; the Contractor will comply with codes, ordinances, regulations, and other legal requirements of public authorities, which bear on the performance of work.
- D. The Contractor shall provide an ESS, installed, programmed, configured, documented, and tested. The security system shall include but not limited to: physical access control, intrusion detection, elevator control interface, video assessment and surveillance, video recording and storage, wireless duress system, fire alarm interface, equipment cabinetry, and uninterruptible power supplies (UPS) interface. Operator training shall not be required as part of the Security Contractors scope and shall be provided by the Owner. The Security Contractor shall still be required to provide necessary maintenance and troubleshooting manuals as well as submittals as identified herein. The work shall include the procurement and installation of electrical wire and cables, the installation and testing of all system components. Inspection, testing, demonstration, and acceptance of equipment, software, materials, installation, documentation, and workmanship, shall be as specified herein. The Contractor shall provide all associated installation support, including the provision of primary electrical input power circuits.

- E. Repair Service Replacement Parts On-site service during the warranty period shall be provided as specified under “Emergency Service”. The Contractor shall guarantee all parts and labor for a term of one (1) year, unless dictated otherwise in this specification from the acceptance date of the system as described in Part 5 of this Specification. The Contractor shall be responsible for all equipment, software, shipping, transportation charges, and expenses associated with the service of the system for one (1) year. The Contractor shall provide 24-hour telephone support for the software program at no additional charge to the owner. Software support shall include all software updates that occur during the warranty period.
- F. Section Includes:
 - 1. Description of Work for Electronic Security Systems,
 - 2. Electronic security equipment coordination with relating Divisions,
 - 3. Submittal Requirements for Electronic Security,
 - 4. Miscellaneous Supporting equipment and materials for Electronic Security,
 - 5. Electronic security installation requirements.

1.2 RELATED WORK

- A. Section 01 00 00 - GENERAL REQUIREMENTS: For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING: Requirements for firestopping application and use.
- C. Section 08 71 00 - DOOR HARDWARE: Requirements for door installation.
- D. Section 10 14 00 - SIGNAGE: Requirements for labeling and signs.
- E. Section 14 21 00 - ELECTRIC TRACTION ELEVATORS: Requirements for elevators.
- F. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements for connection of high voltage.
- G. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Requirements for power cables.
- H. Section 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Requirements for infrastructure.
- I. Section 26 05 41 - UNDERGROUND ELECTRICAL CONSTRUCTION: Requirements for underground installation of wiring.
- J. Section 26 56 00 - EXTERIOR LIGHTING: Requirements for perimeter lighting.
- K. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY: Requirements for conductors and cables.
- L. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY: Requirements for grounding of equipment.

- M. Section 28 05 28.33 - CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY: Requirements for infrastructure.
- N. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEM – EXTENSION: For physical access control integration.
- O. Section 28 16 00 - INTRUSION DETECTION SYSTEM – EXTENSION: Requirements for alarm systems.
- P. Section 28 23 00 - VIDEO SURVEILLANCE SYSTEM – EXTENSION: Requirements for security camera systems.
- Q. Section 28 26 00 - WIRELESS DURESS SYSTEM – EXTENSION: Requirements for emergency and interior communications.

1.3 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project’s sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute’s Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.4 DEFINITIONS

- A. AGC: Automatic Gain Control.
- B. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- C. BICSI: Building Industry Consulting Service International.
- D. CCD: Charge-coupled device.
- E. Central Station: A PC with software designated as the main controlling PC of the security access system. Where this term is presented with initial capital letters, this definition applies.
- F. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.
- G. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- H. CPU: Central processing unit.
- I. Credential: Data assigned to an entity and used to identify that entity.

- J. DGP: Data Gathering Panel – component of the Physical Access Control System capable to communicate, store and process information received from readers, reader modules, input modules, output modules, and Security Management System.
- K. DTS: Digital Termination Service: A microwave-based, line-of-sight communications provided directly to the end user.
- L. EMI: Electromagnetic interference.
- M. EMT: Electric Metallic Tubing.
- N. ESS: Electronic Security System.
- O. File Server: A PC in a network that stores the programs and data files shared by users.
- P. GFI: Ground fault interrupter.
- Q. IDC: Insulation displacement connector.
- R. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- S. I/O: Input/Output.
- T. Intrusion Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.
- U. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- V. LAN: Local area network.
- W. LCD: Liquid-crystal display.
- X. LED: Light-emitting diode.
- Y. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.
- Z. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- AA. M-JPEG: Motion – Joint Photographic Experts Group.
- BB. MPEG: Moving picture experts group.
- CC. NEC: National Electric Code

DD. NEMA: National Electrical Manufacturers Association

EE. NFPA: National Fire Protection Association

FF. NTSC: National Television System Committee.

GG. NRTL: Nationally Recognized Testing Laboratory.

HH. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

II. PACS: Physical Access Control System; A system comprised of cards, readers, door controllers, servers and software to control the physical ingress and egress of people within a given space

JJ. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.

KK. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).

LL. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.

MM. RCDD: Registered Communications Distribution Designer.

NN. RFI: Radio-frequency interference.

OO. RIGID: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.

PP. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.

QQ. RS-485: An TIA/EIA standard for multipoint communications.

RR. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.

SS. SMS: Security Management System – A SMS is software that incorporates multiple security subsystems (e.g., physical access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.

TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

UU. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

VV. UPS: Uninterruptible Power Supply

WW. UTP: Unshielded Twisted Pair

XX. Workstation: A PC with software that is configured for specific limited security system functions.

1.5 QUALITY ASSURANCE

- 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 three years.
 - 2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- C. Contractor Qualification:
 - 1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (PACS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 25 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic

- procedures. The Resident Engineer reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.
2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1 or Level 2 to provide oversight of the project.
 3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.
- D. 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.

1.6 GENERAL ARRANGEMENT OF CONTRACT DOCUMENTS

- A. The Contract Documents supplement to this specification indicates approximate locations of equipment. The installation and/or locations of the equipment and devices shall be governed by the intent of the design; specification and Contract Documents, with due regard to actual site conditions, recommendations, ambient factors affecting the equipment and operations in the vicinity. The Contract Documents are diagrammatic and do not reveal all offsets, bends, elbows, components, materials, and other specific elements that may be required for proper installation. If any departure from the contract documents is deemed necessary, or in the event of conflicts, the Contractor shall submit details of such departures or conflicts in writing to the owner or owner's representative for his or her comment and/or approval before initiating work.
- B. Anything called for by one of the Contract Documents and not called for by the others shall be of like effect as if required or called by all, except if a provision clearly designed to negate or alter a provision contained in one or more of the other Contract Documents shall have the intended effect. In the event of conflicts among the Contract Documents, the Contract Documents shall take precedence in the following order: the Form of Agreement; the Supplemental General Conditions; the Special Conditions; the Specifications with attachments; and the drawings.

1.7 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. 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.
- D. 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. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- E. Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breadth or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings 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 equipment being submitted.

Additional general provisions are as follows:

1. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
2. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.

3. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for Resident Engineer and Contractor review stamps.
4. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with VA CAD Standards CAD Standard Application Guide, and VA BIM Guide. FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. The Contractor shall not reproduce Contract Documents or copy standard information as the basis of the Technical Data Drawings. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the Resident Engineer for approval before the initiation of work.
5. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
 - a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
 - 1) Where two (2) or more binders are necessary to accommodate data; correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-referencing other binders where necessary to provide essential information for communication of proper operation and/or maintenance of the component or system.
 - 2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.
 - b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
 - c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
 - d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.

- e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.
 - 1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.
 - 2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.
 - 3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16" tall.
- f. Manual Content: 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. Furnish four copies, bound in hardback binders, (manufacturer's standard 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) 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.

- i) 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.
 - j) Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
- g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.
- h. Title Page: Provide a title page as the first sheet of each manual to include the following information; project name and address, subject matter covered by the manual, name and address of the Project, date of the submittal, name, address, and telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.
- i. Table of Contents: After the title page, include a type written table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.
- j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.
- k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems, or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.

- l. **Manufacturer's Data:** Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.
 - m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual, prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.
 - n. **Calculations:** Provide a section for circuit and panel calculations.
 - o. **Loading Sheets:** Provide a section for DGP Loading Sheets.
 - p. **Certifications:** Provide section for Contractor's manufacturer certifications.
6. **Contractor Review:** Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer's catalog numbers and conformance of submittal with requirements of contract documents. Return non-conforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor's stamp with signature certifying the review and verification of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.
7. **Resubmission:** Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under procedures specified for initial submittals. Identify all changes made since previous submittal.
8. **Product Data:** Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.

- F. Group 1 Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. Refer to VA Special Conditions Document for drawing format and content requirements. The data package shall include the following:
1. Section I - Drawings:
 - a. General – Drawings shall conform to VA CAD Standards Guide. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings.
 - b. Cover Sheet – Cover sheet shall consist of Project Title and Address, Project Number, Area and Vicinity Maps.
 - c. General Information Sheets – General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Wire and Cable Schedule, Project Phasing, and Sheet Index.
 - d. Floor Plans – Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings. Floor plans shall identify the following:
 - 1) Security devices by symbol,
 - 2) The associated device point number (derived from the loading sheets),
 - 3) Wire and cable types and counts
 - 4) Conduit sizing and routing
 - 5) Conduit riser systems
 - 6) Device and area detail call outs
 - e. Architectural details – Architectural details shall be produced for each device mounting type (door details for EECS and IDS, Intrusion Detection system (motion sensor, keypad, camera, card reader, request-to-exit devices, electromagnetic locks).
 - f. Riser Diagrams – Contractor shall provide a riser diagram indicating riser architecture and distribution of the SMS throughout the facility (or area in scope).
 - g. Block Diagrams – Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., electronic entry control, intrusion detection, closed circuit television, intercom, and other associated subsystems) integration; and data transmission and media conversion methodologies.

- h. Interconnection Diagrams – Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule. Diagram shall also identify interfaces to other systems such as elevator control, fire alarm systems, and security management systems.
- i. Security Details:
 - 1) Panel Assembly Detail – For each panel assembly, a panel assembly details shall be provided identifying individual panel component size and content.
 - 2) Panel Details – Provide security panel details identify general arrangement of the security system components, backboard size, wire through size and location, and power circuit requirements.
 - 3) Device Mounting Details – Provide mounting detailed drawing for each security device (physical access control system, intrusion detection, video surveillance and assessment, and intercom systems) for each type of wall and ceiling configuration in project. Device details shall include device, mounting detail, wiring and conduit routing.
 - 4) Details of connections to power supplies and grounding
 - 5) Details of surge protection device installation
 - 6) Sensor detection patterns – Each system sensor shall have associated detection patterns.
 - 7) Equipment Rack Detail – For each equipment rack, provide a scaled detail of the equipment rack location and rack space utilization. Use of BISCII wire management standards shall be employed to identify wire management methodology. Transitions between equipment racks shall be shown to include use vertical and horizontal latter rack system.
 - 8) Operator Console – The contractor shall provide a layout plan for the Operator Console. The layout plan shall identify all equipment and details associated with the installation.
 - 9) Equipment Room – Equipment room details shall provide architectural, electrical, mechanical, plumbing, IT/Data and associated equipment and device placements both vertical and horizontally.

- j. Electrical Panel Schedule – Electrical Panel Details shall be provided for all SMS systems electrical power circuits. Panel details shall be provided identifying panel type (Standard, Emergency Power, Emergency/Uninterrupted Power Source, and Uninterrupted Power Source Only), panel location, circuit number, and circuit amperage rating.
- k. Door Schedule – A door schedule shall be developed for each door equipped with electronic security components. At a minimum, the door schedule shall be coordinated with Division 08 work and include the following information:
 - 1) Item Number
 - 2) Door Number (Derived from A/E Drawings)
 - 3) Floor Plan Sheet Number
 - 4) Standard Detail Number
 - 5) Door Description (Derived from Loading Sheets)
 - 6) Data Gathering Panel Input Number
 - 7) Door Position or Monitoring Device Type & Model Number
 - 8) Lock Type, Model Number & Power Input/Draw (standby/active)
 - 9) Card Reader Type & Model Number
 - 10) Shunting Device Type & Model Number
 - 11) Sounder Type & Model Number
 - 12) Manufacturer
 - 13) Misc. devices as required
 - a) Delayed Egress Type & Model Number
 - b) Intercom
 - c) Camera
 - d) Electric Transfer Hinge
 - e) Electric Pass-through device
 - 14) Remarks column indicating special notes or door configurations

2. Camera Schedule - A camera schedule shall be developed for each camera. Contractors shall coordinate with the Resident Engineer to determine camera starting numbers and naming conventions. All drawings shall identify wire and cable standardization methodology. Color coding of all wiring conductors and jackets is required and shall be communicated consistently throughout the drawings package submittal. At a minimum, the camera schedule shall include the following information:
 - a. Item Number
 - b. Camera Number
 - c. Naming Conventions
 - d. Description of Camera Coverage
 - e. Camera Location
 - f. Floor Plan Sheet Number
 - g. Camera Type
 - h. Mounting Type
 - i. Standard Detail Reference
 - j. Power Input & Draw
 - k. Power Panel Location
 - l. Remarks Column for Camera
3. Section II – Data Gathering Panel Documentation Package
 - a. Contractor shall provide Data Gathering Panel (DGP) input and output documentation packages for review at the Shop Drawing submittal stage and also with the as-built documentation package. The documentation packages shall be provided in both printed and magnetic form at both review stages.
 - b. The Contractor shall provide loading sheet documentation package for the associated DGP, including input and output boards for all field panels associated with the project. Documentation shall be provided in current version Microsoft Excel spreadsheets following the format currently utilized by VA. A separate spreadsheet file shall be generated for each DGP and associated field panels.

- c. The spreadsheet names shall follow a sequence that shall display the spreadsheets in numerical order according to the DGP system number. The spreadsheet shall include the prefix in the file name that uniquely identifies the project site. The spreadsheet shall detail all connected items such as card readers, alarm inputs, and relay output connections. The spreadsheet shall include an individual section (row) for each panel input, output and card reader. The spreadsheet shall automatically calculate the system numbers for card readers, inputs, and outputs based upon data entered in initialization fields.
- d. All entries must be verified against the field devices. Copies of the floor plans shall be forwarded under separate cover.
- e. The DGP spreadsheet shall include an entry section for the following information:
 - 1) DGP number
 - 2) First Reader Number
 - 3) First Monitor Point Number
 - 4) First Relay Number
 - 5) DGP, input or output Location
 - 6) DGP Chain Number
 - 7) DGP Cabinet Tamper Input Number
 - 8) DGP Power Fail Input Number
 - 9) Number of Monitor Points Reserved For Expansion Boards
 - 10) Number of Control Points (Relays) Reserved For Expansion Boards
- f. The DGP, input module and output module spreadsheets shall automatically calculate the following information based upon the associated entries in the above fields:
 - 1) System Numbers for Card Readers
 - 2) System Numbers for Monitor Point Inputs
 - 3) System Numbers for Control Points (Relays)
 - 4) Next DGP or input module First Monitor Point Number
 - 5) Next DGP or output module First Control Point Number
- g. The DGP spreadsheet shall provide the following information for each card reader:
 - 1) DGP Reader Number
 - 2) System Reader Number
 - 3) Cable ID Number
 - 4) Description Field (Room Number)

- 5) Description Field (Device Type i.e.: In Reader, Out Reader, etc.)
 - 6) Description Field
 - 7) DGP Input Location
 - 8) Date Test
 - 9) Date Passed
 - 10) Cable Type
 - 11) Camera Numbers (of cameras viewing the reader location)
- h. The DGP and input module spreadsheet shall provide the following information for each monitor point (alarm input).
- 1) DGP Monitor Point Input Number
 - 2) System Monitor Point Number
 - 3) Cable ID Number
 - 4) Description Field (Room Number)
 - 5) Description Field (Device Type i.e.: Door Contact, Motion Detector, etc.)
 - 6) DGP or input module Input Location
 - 7) Date Test
 - 8) Date Passed
 - 9) Cable Type
 - 10) Camera Numbers (of associated alarm event preset call-ups)
- i. The DGP and output module spreadsheet shall provide the following information for each control point (output relay).
- 1) DGP Control Point (Relay) Number
 - 2) System (Control Point) Number
 - 3) Cable ID Number
 - 4) Description Field (Room Number)
 - 5) Description Field (Device: Lock Control, Local Sounder, etc.)
 - 6) Description Field
 - 7) DGP or OUTPUT MODULE Output Location
 - 8) Date Test
 - 9) Date Passed Cable Type
 - 10) Camera Number (of associated alarm event preset call-ups)

- j. The DGP, input module and output module spreadsheet shall include the following information or directions in the header and footer:
 - 1) Header
 - a) DGP Input and Output Worksheet
 - b) Enter Beginning Reader, Input, and Output Starting Numbers and Sheet Will Automatically Calculate the Remaining System Numbers.
 - 2) Footer
 - a) File Name
 - b) Date Printed
 - c) Page Number
- 4. Section IV - Manufacturers' Data: The data package shall include manufacturers' data for all materials and equipment, including sensors, local processors and console equipment provided under this specification.
- 5. Section V - System Description and Analysis: The data package shall include system descriptions, analysis, and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance requirements of this specification. The data package shall include the following:
 - a. Central processor memory size; communication speed and protocol description; rigid disk system size and configuration; flexible disk system size and configuration; back-up media size and configuration; alarm response time calculations; command response time calculations; start-up operations; expansion capability and method of implementation; sample copy of each report specified; and color photographs representative of typical graphics.
 - b. Software Data: The data package shall consist of descriptions of the operation and capability of the system, and application software as specified.
 - c. Overall System Reliability Calculations: The data package shall include all manufacturers' reliability data and calculations required to show compliance with the specified reliability.
- 6. Section VI – Certifications & References: All specified manufacturer's certifications shall be included with the data package. Contractor shall provide Project references as outlined in Paragraph 1.4 "Quality Assurance".

G. Group II Technical Data Package

1. The Contractor shall prepare a report of “Current Site Conditions” and submit a report to the Resident Engineer documenting changes to the site, particularly those conditions that affect performance of the system to be installed. The Contractor shall provide specification sheets, or written functional requirements to support the findings, and a cost estimate to correct those site changes or conditions which affect the installation of the system or its performance. The Contractor shall not correct any deficiency without written permission from the COTR.
2. System Configuration and Functionality: The contractor shall provide the results of the meeting with VA to develop system requirements and functionality including but not limited to:
 - a. Baseline configuration
 - b. Access levels
 - c. Schedules (intrusion detection, physical access control, holidays, etc.)
 - d. Badge database
 - e. System monitoring and reporting (unit level and central control)
 - f. Naming conventions and descriptors

H. Group III Technical Data Package

1. Development of Test Procedures: The Contractor will prepare performance test procedures for the system testing. The test procedures shall follow the format of the VA Testing procedures and be customized to the contract requirements. The Contractor will deliver the test procedures to the Resident Engineer for approval at least 60 calendar days prior to the requested test date.

I. Group IV Technical Data Package

1. Performance Verification Test
 - a. Based on the successful completion of the pre-delivery test, the Contractor shall finalize the test procedures and report forms for the performance verification test (PVT) and the endurance test. The PVT shall follow the format, layout and content of the pre-delivery test. The Contractor shall deliver the PVT and endurance test procedures to the Resident Engineer for approval. The Contractor may schedule the PVT after receiving written approval of the test procedures. The Contractor shall deliver the final PVT and endurance test reports within 14 calendar days from completion of the tests. Refer to Part 3 of this section for System Testing and Acceptance requirements.

2. Training Documentation
 - a. New Facilities and Major Renovations: Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for VA technicians and administrative personnel. Training shall include general information on new system layout including closet locations, turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided.
3. System Configuration and Data Entry:
 - a. The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., video matrix switch, digital video recorders, network video recorders). All data entry shall be performed per VA standards & guidelines. The Contractor is responsible for participating in all meetings with the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated in to the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, & program and/or configure the following components:
 - 1) Physical Access control system components,
 - 2) All intrusion detection system components,
 - 3) Video surveillance, control and recording systems,
 - 4) Intercom systems components,
 - 5) All other security subsystems shown in the contract documents.
 - b. The Contractor is responsible for compiling the card access database for the VA employees, including programming reader configurations, access shifts, schedules, exceptions, card classes and card enrollment databases.
 - c. Refer to Part 3 for system programming requirements and planning guidelines.

4. Graphics: Based on CAD as-built drawings developed for the construction project, create all map sets showing locations of all alarms and field devices. Graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points shall be delivered with the system. The Contractor shall create and install all graphics needed to make the system operational. The Contractor shall utilize data from the contract documents, Contractor's field surveys, and all other pertinent information in the Contractor's possession to complete the graphics. The Contractor shall identify and request from the COTR, any additional data needed to provide a complete graphics package. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 203.2 x 254 mm (8 x 10 in) of each type of graphic to be used for the completed Security system. The graphics examples shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.
- J. Group V Technical Data Package: Final copies of the manuals shall be delivered to the Resident Engineer as part of the acceptance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each sub-contractor installing equipment or systems, as well as the nearest service representatives for each item of equipment for each system. The manuals shall include a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. Six (6) hard-copies and one (1) soft copy on CD of each item listed below shall be delivered as a part of final systems acceptance.
 1. Functional Design Manual: The functional design manual shall identify the operational requirements for the entire system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes. Manufacturer developed literature may be used; however, shall be produced to match the project requirements.
 2. Equipment Manual: A manual describing all equipment furnished including:
 - a. General description and specifications; installation and checkout procedures; equipment electrical schematics and layout drawings; system schematics and layout drawings;

alignment and calibration procedures; manufacturer's repair list indicating sources of supply; and interface definition.

3. Software Manual: The software manual shall describe the functions of all software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
 - a. Definition of terms and functions; use of system and applications software; procedures for system initialization, start-up, and shutdown; alarm reports; reports generation, database format and data entry requirements; directory of all disk files; and description of all communications protocols including data formats, command characters, and a sample of each type of data transfer.
4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:
 - a. Computers and peripherals; system start-up and shutdown procedures; use of system, command, and applications software; recovery and restart procedures; graphic alarm presentation; use of report generator and generation of reports; data entry; operator commands' alarm messages, and printing formats; and system access requirements.
5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, recommend schedules, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
6. Spare Parts and Components Data: At the conclusion of the Contractor's work, the Contractor shall submit to the Resident Engineer a complete list of the manufacturer's recommended spare parts and components required to satisfactorily maintain and service the systems, as well as unit pricing for those parts and components.
7. Operation, Maintenance and Service Manuals: The Contractor shall provide two (2) complete sets of operating and maintenance manuals in the form of an instructional manual for use by the VA Security Guard Force personnel. The manuals shall be organized into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder. If multiple volumes are required, each volume shall be fully indexed and coordinated.
8. Equipment and Systems Maintenance Manual: The Contractor shall provide the following descriptive information for each piece of equipment, operating system, and electronic system:
 - a. Equipment and/or system function.

- b. Operating characteristics.
 - c. Limiting conditions.
 - d. Performance curves.
 - e. Engineering data and test.
 - f. Complete nomenclature and number of replacement parts.
 - g. Provide operating and maintenance instructions including assembly drawings and diagrams required for maintenance and a list of items recommended to stock as spare parts.
 - h. Provide information detailing essential maintenance procedures including the following: routine operations, trouble shooting guide, disassembly, repair and re-assembly, alignment, adjusting, and checking.
 - i. Provide information on equipment and system operating procedures, including the following; start-up procedures, routine and normal operating instructions, regulation and control procedures, instructions on stopping, shut-down and emergency instructions, required sequences for electric and electronic systems, and special operating instructions.
 - j. Manufacturer equipment and systems maintenance manuals are permissible.
9. Project Redlines: During construction, the Contractor shall maintain an up-to-date set of construction redlines detailing current location and configuration of the project components. The redline documents shall be marked with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office. The Contractor will provide access to redline documents anytime during the project for review and inspection by the Resident Engineer or authorized Office of Protection Services representative. Master redlines shall be neatly maintained throughout the project and secured under lock and key in the contractor's onsite project office. Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings. Prior to producing Record Construction Documents, the contractor will submit the Master Redline document to the Resident Engineer for review and approval of all changes or modifications to the documents. Each sheet shall have Resident Engineer initials indicating authorization to produce "As Built" documents. Field drawings shall be used for data gathering and field changes. These changes shall be made to the master redline documents daily. Field drawings shall not be considered "master redlines".

10. Record Specifications: The Contractor shall maintain one (1) copy of the Project Specifications, including addenda and modifications issued, for Project Record Documents. The Contractor shall mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in the Contract Specifications and modifications issued. (Note related Project Record Drawing information where applicable). The Contractor shall pay particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Upon completion of the mark ups, the Contractor shall submit record Specifications to the COTR. As with master relines, Contractor shall maintain record specifications for Resident Engineer review and inspection at anytime.
11. Record Product Data: The Contractor shall maintain one (1) copy of each Product Data submittal for Project Record Document purposes. The Data shall be marked to indicate the actual product installed where the installation varies substantially from that indicated in the Product Data submitted. Significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation shall be included. Particular attention will be given to information on concealed products and installations that cannot be readily identified or recorded later. Note related Change Orders and mark up of Record Construction Documents, where applicable. Upon completion of mark up, submit a complete set of Record Product Data to the COTR.
12. Miscellaneous Records: The Contractor shall maintain one (1) copy of miscellaneous records for Project Record Document purposes. Refer to other Specifications for miscellaneous record-keeping requirements and submittals concerning various construction activities. Before substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records include a minimum of the following:
 - a. Certificates received instead of labels on bulk products.
 - b. Testing and qualification of tradesmen. (“Contractor’s Qualifications”)
 - c. Documented qualification of installation firms.
 - d. Load and performance testing.
 - e. Inspections and certifications.
 - f. Final inspection and correction procedures.
 - g. Project schedule

13. Record Construction Documents (Record As-Built)

- a. Upon project completion, the contractor shall submit the project master redlines to the Resident Engineer prior to development of Record construction documents. The Resident Engineer shall be given a minimum of a thirty (30) day review period to determine the adequacy of the master redlines. If the master redlines are found suitable by the Resident Engineer, the Resident Engineer will initial and date each sheet and turn redlines over to the contractor for as built development.
- b. The Contractor shall provide the Resident Engineer a complete set of "as-built" drawings and original master redlined marked "as-built" blue-line in the latest version of AutoCAD drawings unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, data gathering panel number, and input or output number as applicable. All corrective notations made by the Contractor shall be legible when submitted to the COTR. If, in the opinion of the COTR, any redlined notation is not legible, it shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted as built shall be in editable formats and the ownership of the drawings shall be fully relinquished to the owner.
- c. Where feasible, the individual or entity that obtained record data, whether the individual or entity is the installer, sub-contractor, or similar entity, is required to prepare the mark up on Record Drawings. Accurately record the information in a comprehensive drawing technique. Record the data when possible after it has been obtained. For concealed installations, record and check the mark up before concealment. At the time of substantial completion, submit the Record Construction Documents to the COTR. The Contractor shall organize into bound and labeled sets for the COTR's continued usage. Provide device, conduit, and cable lengths on the conduit drawings. Exact in-field conduit placement/routings shall be shown. All conduits shall be illustrated in their entire length from termination in security closets; no arrowed conduit runs shall be shown. Pull box and junction box sizes are to be shown if larger than 100mm (4 inch).

K. FIPS 201 Compliance Certificates

1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:

- a. Card Readers
- L. Approvals will be based on complete submission of manuals together with shop drawings.
- M. 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. Conduit hangers, clamps and supports.
 - 4. Duct sealing compound.

1.8 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. American National Standards Institute (ANSI)/ International Code Council (ICC):
 - A117.1.....Standard on Accessible and Usable Buildings and Facilities
- C. American National Standards Institute (ANSI)/ Security Industry Association (SIA):
 - AC.....Access Control: Access Control Guideline Dye Sublimation
Printing Practices for PVC Access Control Cards
 - CP-01Control Panel Standard-Features for False Alarm Reduction
 - PIR-01Passive Infrared Motion Detector Standard - Features for
Enhancing False Alarm Immunity
 - TVACCCTV to Access Control Standard - Message Set for System
Integration
- D. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):
 - 330Electrical Performance Standards for CCTV Cameras
 - 375A.....Electrical Performance Standards for CCTV Monitors
- E. American National Standards Institute (ANSI):
 - ANSI S3.2-99.....Method for measuring the Intelligibility of Speech over
Communications Systems

- F. American Society for Testing and Materials (ASTM)
 - B1.....Standard Specification for Hard-Drawn Copper Wire
 - B3.....Standard Specification for Soft or Annealed Copper Wire
 - B8.....Standard Specification for Concentric-Lay-Stranded Copper
Conductors, Hard, Medium-Hard, or Soft
 - D2301.....Standard Specification for Vinyl Chloride Plastic Pressure
Sensitive Electrical Insulating Tape
- G. Architectural Barriers Act (ABA)
- H. Department of Justice: American Disability Act (ADA)
 - 28 CFR Part 36- ADA Standards for Accessible Design
- I. Department of Veterans Affairs:
 - VHA National CAD Standard Application Guide, VA BIM Guide, V1.0 10
- J. Federal Communications Commission (FCC):
 - (47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems
- K. Federal Information Processing Standards (FIPS):
 - FIPS-201-1Personal Identity Verification (PIV) of Federal Employees and
Contractors
- L. Federal Specifications (Fed. Spec.):
 - A-A-59544Cable and Wire, Electrical (Power, Fixed Installation)
- M. Government Accountability Office (GAO):
 - GAO-03-8Security Responsibilities for Federally Owned and Leased
Facilities
- N. Homeland Security Presidential Directive (HSPD):
 - HSPDPolicy for a Common Identification Standard for Federal
Employees and Contractors
- O. Institute of Electrical and Electronics Engineers (IEEE):
 - 81IEEE Guide for Measuring Earth Resistivity, Ground
Impedance, and Earth Surface Potentials of a Ground System
 - C2.....National Electrical Safety Code
 - C62.41.....IEEE Recommended Practice on Surge Voltages in Low-Voltage
AC Power Circuits
 - C95.1.....Standards for Safety Levels with Respect to Human Exposure in
Radio Frequency Electromagnetic Fields

P. International Organization for Standardization (ISO):

- 7810 Identification cards – Physical characteristics
- 7811 Physical Characteristics for Magnetic Stripe Cards
- 7816-1 Identification cards - Integrated circuit(s) cards with contacts -
Part 1: Physical characteristics
- 7816-2 Identification cards - Integrated circuit cards - Part 2: Cards with
contacts -Dimensions and location of the contacts
- 7816-3 Identification cards - Integrated circuit cards - Part 3: Cards with
contacts - Electrical interface and transmission protocols
- 7816-10 Identification cards - Integrated circuit cards - Part 4:
Organization, security and commands for interchange
- 14443 Identification cards - Contactless integrated circuit cards;
Contactless Proximity Cards Operating at 13.56 MHz in up to 5
inches distance
- 15693 Identification cards -- Contactless integrated circuit cards -
Vicinity cards; Contactless Vicinity Cards Operating at 13.56
MHz in up to 50 inches distance
- 19794 Information technology - Biometric data interchange formats

Q. National Electrical Contractors Association

- 303 Installing Closed Circuit Television (CCTV) Systems

R. National Electrical Manufacturers Association (NEMA):

- 250-11 Enclosures for Electrical Equipment (1000 Volts Maximum)
- TC-3-11 PVC Fittings for Use with Rigid PVC Conduit and Tubing
- FB1-11 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit,
Electrical Metallic Tubing and Cable

S. National Fire Protection Association (NFPA):

- 70-11 National Electrical Code (NEC)
- 731 Standards for the Installation of Electric Premises Security
Systems
- 99 Health Care Facilities

T. National Institute of Standards and Technology (NIST):

- IR 6887 V2.1.....Government Smart Card Interoperability Specification (GSC-IS)
- Special Pub 800-37Guide for Applying the Risk Management Framework to Federal Information Systems
- Special Pub 800-63Electronic Authentication Guideline
- Special Pub 800-73-3Interfaces for Personal Identity Verification (4 Parts)
 -Pt. 1- End Point PIV Card Application Namespace, Data Model & Representation
 -Pt. 2- PIV Card Application Card Command Interface
 -Pt. 3- PIV Client Application Programming Interface
 -Pt. 4- The PIV Transitional Interfaces & Data Model Specification
- Special Pub 800-79-1Guidelines for the Accreditation of Personal Identity Verification Card Issuers
- Special Pub 800-85B-1DRAFTPIV Data Model Test Guidelines
- Special Pub 800-85A-2PIV Card Application and Middleware Interface Test Guidelines (SP 800-73-3 compliance)
- Special Pub 800-96PIV Card Reader Interoperability Guidelines
- Special Pub 800-104AScheme for PIV Visual Card Topography

U. Occupational and Safety Health Administration (OSHA):

- 29 CFR 1910.97Nonionizing radiation

V. Section 508 of the Rehabilitation Act of 1973

W. Security Industry Association (SIA):

- AG-01Security CAD Symbols Standards

X. Underwriters Laboratories, Inc. (UL):

- 1Flexible Metal Conduit
- 5Surface Metal Raceway and Fittings
- 6Rigid Metal Conduit
- 44Thermoset-Insulated Wires and Cables
- 50Enclosures for Electrical Equipment
- 83Thermoplastic-Insulated Wires and Cables
- 294The Standard of Safety for Access Control System Units
- 305Standard for Panic Hardware

360	Liquid-Tight Flexible Steel Conduit
444	Safety Communications Cables
464	Audible Signal Appliances
467	Electrical Grounding and Bonding Equipment
486A.....	Wire Connectors and Soldering Lugs for Use with Copper Conductors
486C.....	Splicing Wire Connectors
486D.....	Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
486E.....	Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493	Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
514A.....	Metallic Outlet Boxes
514B.....	Fittings for Cable and Conduit
51	Schedule 40 and 80 Rigid PVC Conduit
609	Local Burglar Alarm Units and Systems
634	Standards for Connectors with Burglar-Alarm Systems
636	Standard for Holdup Alarm Units and Systems
639	Standard for Intrusion-Detection Units
651	Schedule 40 and 80 Rigid PVC Conduit
651A.....	Type EB and A Rigid PVC Conduit and HDPE Conduit
752	Standard for Bullet-Resisting Equipment
797	Electrical Metallic Tubing
827	Central Station Alarm Services
1037	Standard for Anti-theft Alarms and Devices
1635	Digital Alarm Communicator System Units
1076	Standards for Proprietary Burglar Alarm Units and Systems
1242	Intermediate Metal Conduit
1479	Fire Tests of Through-Penetration Fire Stops
1981	Central Station Automation System
2058	High Security Electronic Locks
60950	Safety of Information Technology Equipment

60950-1Information Technology Equipment - Safety - Part 1: General
Requirements

Y. Uniform Federal Accessibility Standards (UFAS)

Z. United States Department of Commerce:

Special Pub 500-101Care and Handling of Computer Magnetic Storage Media

1.9 COORDINATION

A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

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

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

1.10 MAINTENANCE & SERVICE

A. General Requirements

1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.

B. Description of Work

1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, physical access control equipment, facility interface, signal transmission equipment, and video equipment.

C. Personnel

1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The Resident Engineer shall be advised in writing of the name of the designated service representative, and of any change in personnel. The Resident Engineer shall be provided copies of system manufacturer certification for the designated service representative.

D. Schedule of Work

1. The work shall be performed during regular working hours, Monday through Friday 8:00 am – 5:00 pm, excluding federal holidays.

E. System Inspections

1. These inspections shall include:
 - a. The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
 - 1) Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
 - 2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices, monitors, picture quality from each camera; check, walk test, and calibrate each sensor; run all system software diagnostics and correct all problems; and resolve any previous outstanding problems.

F. Emergency Service

1. The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.
 - a. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from

notification. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.

- b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.

G. Operation

1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.

H. Records & Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

I. Work Request

1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

J. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the Resident Engineer. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the Resident Engineer. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.

K. Software

1. The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

1.11 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.

1.12 DELIVERY, STORAGE, & HANDLING

- 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 craft 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.
- B. Central Station, Workstations, and Controllers:

1. Store in temperature and humidity controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 10 to 30 deg C (50 to 85 deg F), and not more than 80 percent relative humidity, non-condensing.
2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
3. Mark packing list with designations which have been assigned to materials and equipment for recording in the system labeling schedules generated by cable and asset management system.
4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.13 PROJECT CONDITIONS

- A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
1. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 2 to 50 deg C (36 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 1 enclosure.
 2. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of -18 to 50 deg C (0 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 4X enclosures.
 3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -34 to 50 deg C (-30 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 610 mm (24 in) thick. NEMA 250, Type 4X enclosures.
 4. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
 5. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X enclosures.
- B. Security Environment: Use vandal resistant enclosures in high-risk areas where equipment may be subject to damage.

- C. Console: All console equipment shall, unless noted otherwise, be rated for continuous operation under ambient environmental conditions of 15.6 to 29.4 deg C (60 to 85 deg F) and a relative humidity of 20 to 80 percent.

1.14 EQUIPMENT AND MATERIALS

- 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 prior to final inspection and not more than 90 days after completion of the tests.
 - 3. 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.

1.15 ELECTRICAL POWER

- A. Electrical power of 120 Volts Alternating Current (VAC) shall be indicated on the Division 26 drawings. Additional locations requiring primary power required by the security system shall be shown as part of these contract documents. Primary power for the security system shall be configured to switch to emergency backup sources automatically if interrupted without degradation of any critical system function. Alarms shall not be generated as a result of power switching, however, an indication of power switching on (on-line source) shall be provided to the alarm monitor. The Security Contractor shall provide an interface (dry contact closure) between the PACS and the Uninterruptible Power Supply (UPS) system so the UPS trouble signals and main power fail appear on the PACS operator terminal as alarms.
- B. Failure of any on-line battery shall be detected and reported as a fault condition. Battery backed-up power supplies shall be provided sized for 8 hours of operation at actual connected load. Requirements for additional power or locations shall be included with the contract to support equipment and systems offered. The following minimum requirements shall be provided for power sources and equipment.
 - 1. Emergency Generator
 - a. Report Printers: Unit Control Room
 - b. Video Monitors: Unit Control Room
 - c. Intercom Stations
 - d. Radio System
 - e. Lights: Unit Control Room, Equipment Rooms, & Security Offices
 - f. Outlets: Security Outlets dedicated to security equipment racks or security enclosure assemblies.
 - g. Security Device Power Supplies (DGP, VASS, Card Access, Lock Power, etc.) powered from the security closets or remotely: various locations
 - h. Telephone/Radio Recording Equipment: Unit Control Room.
 - i. VASS Camera Power Supplies: Security Closets
 - j. VASS Pan/Tilt Units: Various Locations
 - k. VASS Outdoor Housing Heaters and Blowers: Various Sites
 - l. Intercom Master Control System
 - m. Fiber Optic Receivers/Transmitters
 - n. Security office Weapons Storage
 - o. Outlets that charge handheld radios

2. Uninterruptible Power Supply (UPS) on Emergency Power
 - a. The following 120VAC circuits shall be provided by others. The Security Contractor shall coordinate exact locations with the Electrical Contractor:
 - 1) Security System Monitors and Keyboards: Control Room
 - 2) CPU: Control Equipment Room
 - 3) Communications equipment: Control Equipment Room and various sites.
 - 4) VASS Matrix Switcher: Control Equipment Room
 - 5) VASS: Control Equipment Room
 - 6) Digital Video Recorders, encoders & decoders: Control Room
 - 7) All equipment Room racked equipment.
 - 8) Network switches

1.16 TRANSIENT VOLTAGE SUPPRESSION, POWER SURGE SUPPRESSION, & GROUNDING

- A. Transient Voltage Surge Suppression: All cables and conductors extending beyond building façade, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection. The TVSS device shall be UL listed in accordance with Standard TIA 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 914.4 mm (3 ft) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode to verify there is no interference.
 1. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
 2. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
 3. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B.
 4. Operating Temperature and Humidity: -40 to 85 deg C (-40 to 185 deg F), 0 to 95 percent relative humidity.
- B. Grounding and Surge Suppression

1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. To ensure the operation of over current devices, such as fuses, circuit breakers, and relays, underground-fault conditions.
2. Security Contractor shall engineer and provide proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards referenced in this document.
3. Principal grounding components and features. Include main grounding buses and grounding and bonding connections to service equipment.
4. Details of interconnection with other grounding systems. The lightning protection system shall be provided by the Security Contractor.
5. Locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
6. AC power receptacles are not to be used as a ground reference point.
7. Any cable that is shielded shall require a ground in accordance with the best practices of the trade and manufactures installation instructions.
8. Protection should be provided at both ends of cabling.

1.17 COMPONENT ENCLOSURES

A. Construction of Enclosures

1. Consoles, power supply enclosures, detector control and terminal cabinets, control units, wiring gutters, and other component housings, collectively referred to as enclosures, shall be so formed and assembled as to be sturdy and rigid.
2. Thickness of metal in-cast and sheet metal enclosures of all types shall not be less than those in Tables I and II, UL 611. Sheet steel used in fabrication of enclosures shall be not less than 14 gauge. Consoles shall be 16-gauge.
3. Doors and covers shall be flanged. Enclosures shall not have pre-punched knockouts. Where doors are mounted on hinges with exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent removal. Doors having a latch edge length of less than 609.6 mm (24 in) shall be provided with a single construction core. Where the latch edge of a hinged door is more than 609.6 mm (24 in) or more in length, the door shall be provided with a three-point latching device with construction core; or alternatively with two, one located near each end.

4. Any ventilator openings in enclosures and cabinets shall conform to the requirements of UL 611. Unless otherwise indicated, sheet metal enclosures shall be designed for wall mounting with tip holes slotted. Mounting holes shall be in positions that remain accessible when all major operating components are in place and the door is open, but shall be in accessible when the door is closed.
 5. Covers of pull and junction boxes provided to facilitate initial installation of the system shall be held in place by tamper proof Torx Center post security screws. Stenciled or painted labels shall be affixed to such boxes indicating they contain no connections. These labels shall not indicate the box is part of the Electronic Security System (ESS).
- B. Consoles & Equipment Racks: All consoles and vertical equipment racks shall include a forced air-cooling system to be provided by others.
1. Vertical Equipment Racks:
 - a. The forced air blowers shall be installed in the vented top of each cabinet and shall not reduce usable rack space.
 - b. The forced air fan shall consist of one fan rated at 105 CFM per rack bay and noise level shall not exceed 55 decibels.
 - c. Vertical equipment racks are to be provided with full sized clear plastic locking doors and vented top panels as shown on contract drawings.
 2. Console racks:
 - a. Forced air fans shall be installed in the top rear of each console bay. The forced air fan shall consist of one fan rated at 105 CFM mounted to a 133mm vented blank panel the noise level of each fan shall not exceed 55 decibels. The fans shall be installed so air is pulled from the bottom of the rack or cabinet and exhausted out the top.
 - b. Console racks are to be provided with flush mounted hinged rear doors with recessed locking latch on the bottom and middle sections of the consoles. Provide code access to support wiring for devices located on the work surfaces.
- C. Tamper Provisions and Tamper Switches:
1. Enclosures, cabinets, housings, boxes and fittings or every product description having hinged doors or removable covers and which contain circuits, or the integrated security system and its power supplies shall be provided with cover operated, corrosion-resistant tamper switches.

2. Tamper switches shall be arranged to initiate an alarm signal that will report to the monitoring station when the door or cover is moved. Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed. It shall take longer than 1 second to depress or defeat the tamper switch after opening or removing the cover. The enclosure and tamper switch shall function together in such a manner as to prohibit direct line of sight to any internal component before the switch activates.
3. Tamper switches shall be inaccessible until the switch is activated. Have mounting hardware concealed so the location of the switch cannot be observed from the exterior of the enclosure. Be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating. Be spring-loaded and held in the closed position by the door or cover and be wired so they break the circuit when the door cover is disturbed. Tamper circuits shall be adjustable type screw sets and shall be adjusted by the contractor to eliminate nuisance alarms associated with incorrectly mounted tamper device shall annunciate prior to the enclosure door opening (within 1/4 " tolerance. The tamper device or its components shall not be visible or accessible with common tools to bypass when the enclosure is in the secured mode.
4. The single gang junction boxes for the portrait alarming and pull boxes with less than 102 square mm will not require tamper switches.
5. All enclosures over 305 square mm shall be hinged with an enclosure lock.
6. Control Enclosures: Maintenance/Safety switches on control enclosures, which must be opened to make routing maintenance adjustments to the system and to service the power supplies, shall be push/pull-set automatic reset type.
7. Provide one (1) enclosure tamper switch for each 609 linear mm of enclosure lock side opening evenly spaced.
8. All security screws shall be Torx-Post Security Screws.
9. The contractor shall provide the owner with two (2) torx-post screwdrivers.

1.18 ELECTRONIC COMPONENTS

- A. All electronic components of the system shall be of the solid-state type, mounted on printed circuit boards conforming to UL 796. Boards shall be plug-in, quick-disconnect type. Circuitry shall not be so densely placed as to impede maintenance. All power-dissipating components shall incorporate safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and current-carrying capacity.

1.19 SUBSTITUTE MATERIALS & EQUIPMENT

- A. Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS 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.
- B. In addition to this Section the Security Contractor shall also reference Section II, Products and associated divisions. The Resident Engineer shall have final authority on the authorization or refusal of substitutions. If there are no proposed substitutions, a statement in writing from the Contractor shall be submitted to the Resident Engineer stating same. In the preparation of a list of substitutions, the following information shall be included, as a minimum:
1. Identity of the material or devices specified for which there is a proposed substitution.
 2. Description of the segment of the specification where the material or devices are referenced.
 3. Identity of the proposed substitute by manufacturer, brand name, catalog or model number and the manufacturer's product name.
 4. A technical statement of all operational characteristic expressing equivalence to items to be substituted and comparison, feature-by-feature, between specification requirements and the material or devices called for in the specification; and Price differential.
- C. Materials Not Listed: Furnish all necessary hardware, software, programming materials, and supporting equipment required to place the specified major subsystems in full operation. Note that some supporting equipment, materials, and hardware may not be described herein. Depending on the manufacturers selected by the COTR, some equipment, materials and hardware may not be contained in either the Contract Documents or these written specifications, but are required by the manufacturer for complete operation according to the intent of the design and these specifications. In such cases, the Resident Engineer shall be given the opportunity to approve the additional equipment, hardware and materials that shall be fully identified in the bid and in the equipment list submittal. The Resident Engineer shall be consulted in the event there is any question about which supporting equipment, materials, or hardware is intended to be included.

- D. Response to Specification: The Contractor shall submit a point-by-point statement of compliance with each paragraph of the security specification. The statement of compliance shall list each paragraph by number and indicate “COMPLY” opposite the number for each paragraph where the Contractor fully complies with the specification. Where the proposed system cannot meet the requirements of the paragraph, and does not offer an equivalent solution, the offers shall indicate “DOES NOT COMPLY” opposite the paragraph number. Where the proposed system does not comply with the paragraph as written, but the bidder feels it will accomplish the intent of the paragraph in a manner different from that described, the offers shall indicate “COMPARABLE”. The offers shall include a statement fully describing the “comparable” method of satisfying the requirement. Where a full and concise description is not provided, the offered system shall be considered as not complying with the specification. Any submission that does not include a point-by-point statement of compliance, as described above, shall be disqualified. Submittals for products shall be in precise order with the product section of the specification. Submittals not in proper sequence will be rejected.

1.20 LIKE ITEMS

- A. Where two or more items of equipment performing the same function are required, they shall be exact duplicates produced by one manufacturer. All equipment provided shall be complete, new, and free of any defects.

1.21 WARRANTY

- A. The Contractor shall, as a condition precedent to the final payment, execute a written guarantee (warranty) to the COTR certifying all contract requirements have been completed according to the final specifications. Contract drawings and the warranty of all materials and equipment furnished under this contract are to remain in satisfactory operating condition (ordinary wear and tear, abuse and causes beyond his control for this work accepted) for one (1) year from the date the Contractor received written notification of final acceptance from the COTR. Demonstration and training shall be performed prior to system acceptance. All defects or damages due to faulty materials or workmanship shall be repaired or replaced without delay, to the COTR's satisfaction, and at the Contractor's expense. The Contractor shall provide quarterly inspections during the warranty period. The contractor shall provide written documentation to the COTR on conditions and findings of the system and device(s). In addition, the contractor shall provide written documentation of test results and stating what was done to correct any deficiencies. The first inspection shall occur 90 calendar days after the acceptance date. The last inspection shall occur 30 calendar days prior to the end of the warranty. The warranty period shall be extended until

the last inspection and associated corrective actions are complete. When equipment and labor covered by the Contractor's warranty, or by a manufacturer's warranty, have been replaced or restored because of its failure during the warranty period, the warranty period for the replaced or repaired equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

1.22 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.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. All equipment associated within the Security Control Room, Security Console and Security Equipment Room shall be UL 827, UL 1981, and UL 60950 compliant and rated for continuous operation. Environmental conditions (i.e. temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.
- B. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 50 Hz or 60 Hz AC power system unless documented otherwise in subsequent sections listed within this specification. All equipment shall have a back-up source of power that will provide a minimum of 8 hours of run time in the event of a loss of primary power to the facility.
- C. The system shall be designed, installed, and programmed in a manner that will allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.
- D. All equipment and materials for the system will be compatible to ensure correct operation.

2.2 EQUIPMENT ITEMS

- A. The Security Management System shall provide full interface with all components of the security subsystem as follows:
 - 1. Shall allow for communication between the Physical Access Control System and Database Management and all subordinate work and monitoring stations, enrollment centers for badging and biometric devices as part of the PACS, local annunciation centers, the electronic Security Management System (SMS), and all other VA redundant or backup command center or other workstations locations.

2. Shall provide automatic continuous communication with all systems that are monitored by the SMS, and shall automatically annunciate any communication failures or system alarms to the SMS operator providing identification of the system, nature of the alarm, and location of the alarm.
 3. Controlling devices shall be utilized to interface the SMS with all field devices.
 4. The Security control room and security console will be supported by an uninterrupted power supply (UPS) or dedicated backup generator power circuit.
 5. The Security Operator Console shall house the following equipment i.e. refer to individual master specifications for each security subsystem's specific requirements:
 - a. Security Console Bays and Equipment Racks
 - b. Security Network Server and Workstation
 - c. CCTV Monitoring, Controlling, and Recording Equipment
 - d. PACS Monitoring and Controlling Equipment
 - e. IDS Monitoring and Controlling Equipment
 - f. Security Access Detection Monitoring Equipment
 - g. Main Panels for all Security Systems
 - h. Power Supply Units (PSU) for all field devices
 - i. Life safety and power monitoring equipment
 - j. All other building systems deemed necessary by the VA to include, but not limited to, heating, ventilation and air conditioning (HVAC), elevator control, portable radio, fire alarm monitoring, and other potential systems.
- B. Security Console Bays - shall be EIA 310D compliant and:
1. Utilize stand-up, sit-down, and vertical equipment racks in any combination to monitor and control the security subsystems.
 2. Shall be wide enough for equipment that requires a minimum 19 inch (47.5 cm) mounting area.
 3. Shall be made of metal, furnished with wire ways, a power strip, a thermostatic controlled bottom or top mounted fan units, a hinge mounted rear door, a hinge mounted front door made of Plexiglas, and a louvered top. When possible, pre-fabricated (standard off-the-shelf) security console equipment shall be used in place of customized designed consoles.

4. A wire management system shall be designed and installed so that all cables are mounted in a manner that they do not interfere with day-to-day operations, are labeled for quick identification, and so that high voltage power cables do not cause signal interference with low voltage and data carrying cables.
5. Shall be mounted on lockable casters.
6. Shall be ergonomically designed so that all devices requiring repetitive interaction with by the operator can be easily accessed, observed, and accomplished.
7. Controls and displays shall be located so that they are not obscured during normal operation. Control and display units installed with a work bench shall be a minimum of 3 in. (7.5 cm) from all edges of the work bench area.
8. All security subsystem controls shall be installed within the same operating console bay of their associated equipment.
9. Video monitors shall be mounted above all controls within a console bay and positioned in a manner that minimum strain is placed on the operator viewing them at the console.
10. At least one workbench for every three (3) console bays shall be provided free of control equipment to allow for appropriate operator workspace.
11. All console devices shall be labeled and marked with a minimum of quarter inch bold print.
12. All non-security related equipment that is required to be monitored shall be installed in a console bay separate from the security subsystem equipment and clearly be identified as such.
13. Console bays and related equipment shall be arranged in priority order and sequenced based upon their pre-defined security subsystem operations criticality established by the Contracting Officer.

14. The following minimum console technical characteristics shall be taken into consideration when designing for and installing the security console and equipment racks:

	Stand-Up	Sit-Down	Vertical Equipment Rack
Workstation Height	No Greater than 84 in. (210 cm)	No greater than 72 in. (150 cm)	No greater than 96 in. (240 cm)
Bench board Slope	21 in. (52.5 cm)	25 in. (62.5 cm)	N/A
Bench board Angle	15 degrees	15 degrees	N/A
Depth of Console	24 in. (60 cm)	24 in. (60 cm)	N/A
Leg and Feet Clearance	6 sq. ft. from center of Console Slope front	6 sq. ft. from center of Console Slope front	6 sq. ft. from center of Console Slope front
Distance Between Console Rows	96 in. (240 cm)	96 in. (240 cm)	96 in. (240 cm)
Distance Between Console and Wall	36 in. (90 cm) from the rear and/or side of console or rack	36 in. (90 cm) from the rear and/or side of console or rack	36 in. (90 cm) from the rear and/or side of console or rack

C. Security Console Configuration:

1. The size shall be defined by the number of console bays required to house and operate the security subsystems, as well as any other factors that may influence the overall design of the space. A small Access Control System and Database Management shall contain no more than four (4) security console bays. A large Access Control System and Database Management shall contain no less than five (5) and no more than eight (8) security console bays.
2. Shall meet the following minimum spacing requirements to ensure that a Access Control System and Database Management is provided to house existing and future security subsystems and other equipment listed in paragraph 2.3.C:
 - a. 500 square feet for a large Access Control System and Database Management.
 - b. 300 square feet for a small Access Control System and Database Management.
 - c. If office, training room and conference space, is a processing area as well as holding cell space is to be located adjacent to the Access Control System and Database Management, these space requirements also need to be considered.

3. Shall be located in an area within, at a minimum, the first level/line of security defense defined by the VA. If the Access Control System and Database Management is to be located outside the first level of security, then the area shall be constructed or retrofit to meet or exceed those requirements outlined in associated VA Master Specifications.
4. Shall not be located within or near an area with little to no blast mitigation standoff space protection, adjacent to an outside wall exposed to vehicle parking and traffic, within a basement or potential flood zone area, in close proximity to major utility areas, or near an exposed air intake(s).
5. Access shall meet UFAS and ADA accessibility requirements.
6. Construction shall be slab to slab and free of windows, with the exception of a service window. All penetrations into the room shall be sealed with fire stopping materials. This material shall apply in accordance with Section 07 84 00, FIRESTOPPING.
7. A service window shall be installed in the wall next to the main entrance of the Access Control System and Database Management or where it best can be monitored and accessed by the security console operator. The window shall meet all requirements set forth in UL 752, to include at a minimum, Class III ballistic level protection. The windows shall be set in a minimum of four (4) inches (100 mm) solid concrete units to ceiling height with either masonry or gypsum wall board to the underside of the slab above. It shall also contain a service tray constructed in a manner that only objects no larger than 3 inches (7.5 cm) in width may pass through it.
8. The walls making up or surrounding the Access Control System and Database Management shall be made of materials that at a minimum offer Class III ballistic level protection for the security console operator(s).
9. There will be a main power cut-off button/switch located inside the Access Control System and Database Management in the event of an electrical fire or related event occurs.
10. Shall have a fire alarm detection unit that is tied into the main building fire alarm system and have at least two fire extinguishers located within it.
11. Shall utilize a fire suppression system similar to that used by the VA's computer and telecommunications room operating areas.
12. The floor shall be raised a minimum of 4 inches (10 cm) from the concrete floor base. Wire ways shall be utilized under the raised floor for separation of signal and power wires and cables.

13. Access shall be monitored and controlled by the PACS via card reader and fixed camera that utilizes a wide angle lens. A 1 in. (2.5 cm) deadbolt shall be utilized as a mechanical override for the door in the event of electrical failure of the PACS, card reader, or locking mechanism.
14. There shall only be one point of ingress and egress to and from the Security Control Room. The door shall be made of solid core wood or better. If a window is required for the door, then the window shall be ballistic resistant with a Millar covering.
15. A two-way intercom shall be placed at the point of entry into the Security Control Room for access-communication control purposes.
16. A remote push-button door unlocking device shall not be installed for the electronic PACS locking mechanism providing access control into the Security Control Room.
17. All controlling equipment and power supplies that must be wall mounted shall be mounted in a manner that maximizes usability of the Security Control Room wall space. All equipment shall be mounted to three quarter inch fire retardant plywood. The plywood shall be fastened to the wall from slab to slab and fixed to the existing walls supports.

D. Security Console Ventilation

1. Shall meet or exceed all requirements laid out in Division 23, HEATING, VENTILATION, AND AIR CONDITIONING.

E. Security Console Lighting:

1. The following factors shall be taken into consideration for lighting of the Security Console area:
 - a. Shadows: To reduce eye strain and fatigue, shadows shall be avoided.
 - b. Glare: The readability of all display panels, labels, and equipment shall not be interfered with or create visibility problems.

2. The following table shall provide guidance on the amount of footcandles required per work area and type of task performed:

Work Area/Type of Task		Footcandles
Main Operating Panels		50
Secondary Display Panels		50
Seated Workstations		100
Reading	Handwriting	100
	Typed Documents	50
	Visual Display Units	10
Logbook Recording		100
Maintenance Area		50
Emergency/Back-up Lighting		10

- F. Existing remote security console access: For facilities that have a remote, secondary back-up control console or workstation shall apply the following requirements:
 1. The secondary stations shall the requirements outlined in Sections 2.2.A-G.
 2. Installation of an intercom station or telephone line shall be installed and provide direct one touch call-up for communications between the primary Security Control Console and secondary Security Control Console.
 3. Secondary stations shall not have priority over a primary Security Control Console.
 4. The primary Access Control System and Database Management shall have the ability to shut off power and a signal to a secondary control station in the event the area has been compromised.
- G. Wires and Cables:
 1. Shall meet or exceed the manufactures recommendation for power and signals.
 2. Shall be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in flexible metal, rigid galvanized steel (RGS) to include the equivalent of liquid tight, polyvinylchloride (PVC) Schedule 40 or 80.
 3. All conduits will be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space will contained in either EMT or RGS conduit.
 4. All conduit, pull boxes, and junction boxes shall be marked with colored permanent tape or paint that will allow it to be distinguished from all other infrastructure conduit.

5. Conduit fills shall not exceed 50 percent unless otherwise documented.
6. A pull string shall be pulled along and provided with signal and power cables to assist in future installations.
7. At all locations where there is a wall penetration or core drilling is conducted to allow for conduit to be installed, fire stopping materials shall be applied to that area.
8. High voltage and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High voltage for the security subsystems shall be any cable or sets of cables carrying 30 VDC/VAC or higher.
9. For all equipment that is carrying digital data between the Security Control Room, Security Equipment Room, Security Console, or at a remote monitoring station, it shall not be less than 20 AWG and stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100% coverage. Cables with a single overall shield shall have a tinned copper shield drain wire.

2.3 FIBER OPTIC EQUIPMENT

A. Fiber Optic Transmitters: The central-located fiber optic transmitters shall utilize wave division multiplexing to transmit video and signals over standard 62.5/125 multimode fibers.

1. The units shall be capable of operating over a range of 4.8 km.
2. The units shall be NTSC color compatible.
3. The units shall support data rates up to 64 Kbps.
4. The units shall be surface or rack mountable.
5. The units shall be UL listed.
6. The units shall meet or exceed the following specifications:
 - a. Video
 - 1) Input: 1 volt pk-pk (75 ohms)
 - 2) Bandwidth: 5Hz - 10 MHz
 - 3) Differential Gain: <5%
 - 4) Tilt: <1%
 - 5) Signal-Noise: 60db
 - 6) Wavelength: 850nm
 - 7) Number of Fibers: 1
 - 8) Operating Temp: -20 to 70 deg C (-4 to 158 deg F)
 - 9) Connectors:
 - a) Power: Female plug with screw clamps

b) Video: BNC

c) Optical: ST

10) Power: 12 VDC

B. Fiber Optic Receivers: The field-located fiber optic receivers shall utilize wave division multiplexing to receive video signals over standard 62.5/125 multimode fiber.

1. The units shall be capable of operating over a range of 4.8 km.
2. The units shall be NTSC color compatible.
3. The units shall support data rates up to 64 Kbps.
4. The units shall be surface or rack mountable.
5. The units shall be UL listed.
6. The units shall meet or exceed the following specifications:

a. Video

- 1) Output: 1 volt pk-pk (75 ohms)
- 2) Bandwidth: 5Hz - 10 MHz
- 3) Differential Gain: <5%
- 4) Tilt: <1%
- 5) Signal-Noise: 60dB
- 6) Wavelength: 850nm
- 7) Number of Fibers: 1
- 8) Surface Mount: 106.7 x 88.9 x 25.4 mm (4.2 x 3.5 x 1 in)
- 9) Operating Temp: -20 to 70 deg C (-4 to 158 deg F)
- 10) Connectors:
 - a.) Power: Female plug block with screw clamps
 - b.) Video: BNC
 - c.) Optical: ST

11) Power: 12 VAC 8 Channel Fiber Optic Transceivers (Video and PTZ Control)

C. Fiber Optic Sub Rack with Power Supply

1. The Card Cage Rack shall provide high-density racking for fiber-optic modules. The unit shall be designed to mount in standard 483 mm (19 in) instrument racks and to accommodate the equivalent of 15 1-inch modules.
 - a. Specifications
 - 1) Card Orientation: Vertical
 - 2) Construction: Aluminum

- 3) Current Consumption: 0.99 A
- 4) Humidity: 95.0 % RH
- 5) Input Power: 100-240 VAC, 60/50 Hz
- 6) Mounting: Mounts in standard 483 mm (19 in) rack using four (4) screws (optional wall brackets purchased separately)
- 7) Number of Outputs: 1.0
- 8) Number of Slots 15.0
- 9) Operating Temperature: -40 to +75 deg C (-40.0 to 167.0 deg F)
- 10) Output Voltage: 13.5 V
- 11) Output Current 6.0 A
- 12) Power Dissipation: 28.0 W
- 13) Power Factor: 48.0
- 14) Power Supply: (built-in)
- 15) Rack Units: 3RU
- 16) Redundant Capability: Yes
- 17) Weight: 2.43 kg (5.35 lb)
- 18) Width: 483 mm (19.0 in)

2.4 TRANSIENT VOLTAGE SURGE SUPPRESSION DEVICES (TVSS) AND SURGE SUPPRESSION

A. Transient Voltage Surge Suppression

1. All cables and conductors extending beyond building perimeter, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage surge suppression protection (TVSS) UL listed in accordance with Standard 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 915 mm (36 in) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:
 - a. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
 - b. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

- c. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B or approved equivalent.
- d. Operating Temperature and Humidity: -40 to + 85 deg C (-40 to 185 deg F), and 0 to 95 percent relative humidity, non-condensing.

B. Physical Access Control Systems

1. Suppressors shall be installed on AC power at the point of service and shall meet the following criteria:
 - a. UL1449 2nd Edition, 2007, listed
 - b. UL1449 S.V.R. of 400 Volts or lower
 - c. Status Indicator Light(s)
 - d. Minimum Surge Current Capacity: 40,000 Amps (8 x 20 μ sec)
 - e. Maximum Continuous Current: 15 Amps
 - f. MCOV: 125 VAC
 - g. Service Voltage: 110-120 VAC
2. Suppressors shall be installed on the Low Voltage circuit at both the point of entrance and exit of the building. Suppressors shall meet the following criteria:
 - a. UL 497B
 - b. Minimum Surge Current Capacity: 2,000 Amps per pair
 - c. Maximum Continuous Current: 5 Amps
 - d. MCOV: 33 Volts
 - e. Service Voltage: 24Volts
3. Suppressors shall be installed on the communication circuit between the access controller and card reader at both the entrance and exit of the building. Suppressors shall meet the following criteria:
 - a. Conforms with UL497B standards (where applicable)
 - b. Clamp level for 12 and 24V power: 18VDC / 38VDC
 - c. Clamp level for Data/LED: 6.8VDC
 - d. Service Voltage for Power: 12VDC/24VDC
 - e. Service Voltage for Data/LED: <5VDC
 - f. Clamp level – PoE Access Power: 72V
 - g. Clamp level – PoE Access Data: 7.9V
 - h. Service Voltage – PoE Access: 48VAC – 54VAC
 - i. Service Voltage – PoE Data: <5VDC

C. Intercom Systems

1. Suppressors shall be installed on the AC power at the point of service and shall meet the following criteria:
 - a. UL 1449 Listed
 - b. UL 1449 S.V.R. of 400 Volts or lower
 - c. Diagnostic Indicator Light(s)
 - d. Integrated ground terminating post (where case/chassis ground exists)
 - e. Minimum Surge Current Capacity of 13,000 Amps (8 x 20 μ Sec)
2. Suppressors shall be installed on incoming central office lines and shall meet the following criteria:
 - a. UL 497A Listed
 - b. Multi Stage protection design
 - c. Auto-reset current protection not to exceed 2 Amps per pair
 - d. Minimum Surge Current of 500 Amps per pair (8 x 20 μ Sec)
3. Suppressors shall be installed on all telephone/intercom circuits that enter or leave separate buildings and shall meet the following criteria:
 - a. UL 497A Listed (where applicable)
 - b. UL 497B Listed (horns, strobes, speakers or communication circuits over 300 feet)
 - c. Multi Stage protection design
 - d. Auto-reset over-current protection not to exceed 5 Amps per pair
 - e. Minimum Surge Current of 1000 Amps per pair (8 x 20 μ Sec)

D. Intrusion Detection Systems

1. Suppressors shall be installed on AC at the point of service and shall meet the following criteria:
 - a. UL 1449, 2nd Edition 2007, listed
 - b. UL 1449 S.V.R. of 400 Volts or lower
 - c. Status Indicator Lights
 - d. Center screw for terminating Class II transformers
 - e. Minimum Surge Current Capacity of 32,000 Amps (8 x 20 μ Sec)
2. Suppressors shall be installed on all Telephone Communication Interface circuits and shall meet the following criteria:
 - a. UL 497A Listed
 - b. Multi Stage protection design

- c. Surge Current Capacity: 9,000 Amps (8x20 μ Sec)
 - d. Clamp Voltage: 130Vrms
 - e. Auto reset current protection not to exceed 150 milliAmps
- 3. Suppressors shall be installed on all burglar alarm initiating and signaling loops and addressable circuits which enter or leave separate buildings. The following criteria shall be met:
 - a. UL 497B for data communications or annunciation (powered loops)
 - b. Fail-short/fail-safe mode.
 - c. Surge Current Capacity: 9,000 Amps (8x20 μ Sec)
 - d. Clamp Voltage: 15 Vrms
 - e. Joule Rating: 76 Joules per pair (10x1000 μ Sec)
 - f. Auto-reset current protection not to exceed 150 milli Amps for UL 497A devices.
- E. Video Surveillance System
 - 1. Protectors shall be installed on coaxial cable systems on points of entry and exit from separate buildings. Suppressors shall be installed at each exterior camera location and include protection for 12 and/or 24 volt power, data signal and motor controls (for Pan, Tilt and Zoom systems). SPDs shall protect all modes herein mentioned and contain all modes in a single unit system. Protection for all systems mentioned above shall be incorporated at the head end equipment. Additionally a minimum 450VA battery backup shall be used to protect the DVR or VCR and monitor. Protectors shall meet the following criteria:
 - a. Head-End Power
 - 1) UL 1778, cUL (Battery Back Up)
 - 2) Minimum Surge Current Capacity: 65,000 Amps (8x20 μ sec)
 - 3) Minimum of two (2) NEMA 5-15R Receptacles (one (1) AC power only, one (1) with UPS)
 - 4) All modes protected (L-N, L-G, N-G)
 - 5) EMI/RFI Filtering
 - 6) Maximum Continuous Current: 12 Amps
 - b. Camera Power
 - 1) Minimum Surge Current Capacity: 1,000 Amps (8X20 μ sec); 240 Amps for IP Video/PoE cameras
 - 2) Screw Terminal Connection
 - 3) All protection modes L-G (all Lines)

4) MCOV <40VAC

c. Video And Data

1) Surge Current Capacity 1,000 Amps per conductor

2) "BNC" Connection (Coax)

3) Protection modes: L-G (Data), Center Pin-G, Shield-G (Coax)

4) Band Pass 0-2GHz

5) Insertion Loss <0.3dB

F. Grounding and Surge Suppression

1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. This is to ensure the operation of over current devices, such as fuses, circuit breakers, and relays, underground-fault conditions.
2. The Contractor shall engineer, provide, and install proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards, referenced in this document.
3. Principal grounding components and features shall include: main grounding buses, grounding, and bonding connections to service equipment.
4. The Contractor shall provide detail drawings of interconnection with other grounding systems including lightning protection systems.
5. The Contractor shall provide details of locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
6. AC power receptacles are not to be used as a ground reference point.
7. Any cable that is shielded shall require a ground in accordance with applicable codes, the best practices of the trade, and all manufacturers' installation instructions.

G. 120 VAC Surge Suppression

1. Continuous Current: Unlimited (parallel connection)
2. Max Surge Current: 13,500 Amps
3. Protection Modes: L - N, L - G, N - G
4. Warranty: Ten Year Limited Warranty
5. Dimension: 73.7 x 41.1 x 52.1 mm (2.90 x 1.62 x 2.05 in)
6. Weight: 2.88 g (0.18 lbs)
7. Housing: ABS

2.5 INSTALLATION KIT

A. General:

1. 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. All unused and partially opened installation kit boxes, coaxial, fiber-optic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware shall be turned over to the Contracting Officer. The following sections outline the minimum required installation sub-kits to be used:
2. System Grounding:
 - a. The grounding kit shall include all cable and installation hardware required. All head end equipment and power supplies shall be connected to earth ground via internal building wiring, according to the NEC.
 - b. This includes, but is not limited to:
 - 1) Coaxial Cable Shields
 - 2) Control Cable Shields
 - 3) Data Cable Shields
 - 4) Equipment Racks
 - 5) Equipment Cabinets
 - 6) Conduits
 - 7) Cable Duct blocks
 - 8) Cable Trays
 - 9) Power Panels
 - 10) Grounding
 - 11) Connector Panels
3. 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.

4. 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.
5. 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.
6. 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.
7. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to label each subsystem according to the OEM requirements, as-installed drawings, and this document.
8. 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 provide the system documentation as required by this document and explained herein.

PART 3 – EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY

INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. Equipment location shall be as close as practical to locations shown on the drawings.

G. 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. "Conveniently 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.

3.2 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Section 07 84 00 FIRESTOPPING.

3.3 DEMONSTRATION AND 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.
- D. Provide services of manufacturer's technical representative for 8 hours to instruct VA personnel in operation and maintenance of units.
- E. Submit training plans and instructor qualifications.

3.4 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 electronic safety and security 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 conduit with other trades to minimize interferences. See the GENERAL CONDITIONS.

3.5 SYSTEM PROGRAMMING

A. General Programming Requirements

1. This following section shall be used by the contractor to identify the anticipated level of effort (LOE) required setup, program, and configure the Electronic Security System (ESS). The contractor shall be responsible for providing all setup, configuration, and programming to include data entry for the Security Management System (SMS) and subsystems (e.g., video matrix switch, intercoms, digital video recorders, intrusion devices, including integration of subsystems to the SMS (e.g., camera call up, time synchronization, intercoms). System programming for existing or new SMS servers shall not be conducted at the project site.

B. Level of Effort for Programming

1. The Contractor shall perform and complete system programming (including all data entry) at an offsite location using the Contractor's own copy of the SMS software. The Contractor's copy of the SMS software shall be of the Owners current version. Once system programming has been completed, the Contractor shall deliver the data to the Resident Engineer on data entry forms and an approved electronic medium, utilizing data from the contract documents. The completed forms shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires it. The Contractor shall not upload system programming until the Resident Engineer has provided written approval. The Contractor is responsible for backing up the system prior to uploading new programming data. Additional programming requirements are provided as follows:
 - a. Programming for New SMS Server: The contractor shall provide all other system related programming. The contractor will be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, personnel photos, access schedules, personnel groupings) along with coordinating with Resident Engineer for device configurations, standards, and groupings. VA shall provide database to support Contractor's data entry tasks. The contractor shall anticipate a weekly coordination meeting and working with Resident Engineer to ensure data uploading is performed without incident of loss of function or data loss.

- b. Programming for Existing SMS Servers: The contractor shall perform all related system programming except for personnel data as noted. The contractor will not be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, access schedules, personnel groupings). The contractor shall anticipate a weekly coordination meeting and working alongside of Resident Engineer to ensure data uploading is performed without incident of loss of function or data loss. System programming for SMS servers shall be performed by using the Contractor's own server and software. These servers shall not be connected to existing devices or systems at any time.
- 2. The Contractor shall identify and request from the Resident Engineer, any additional data needed to provide a complete and operational system as described in the contract documents.
- 3. Contractor and Resident Engineer coordination on programming requires a high level of coordination to ensure programming is performed in accordance with VA requirements and programming uploads do not disrupt existing systems functionality. The contractor shall anticipate a minimum a weekly coordination meeting. Contractor shall ensure data uploading is performed without incident of loss of function or data loss. The following Level of Effort Chart is provided to communicate the expected level of effort required by contractors on VA ESS projects. Calculations to determine actual levels of effort shall be confirmed by the contractor before project award.

Refer to Table 1: Contractor Level of Effort

3.6 TESTING AND ACCEPTANCE

A. Performance Requirements

- 1. General:
 - a. The Contractor shall perform contract field, performance verification, and endurance testing and make adjustments of the completed security system when permitted. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the Resident Engineer at least 60 calendar days prior to the test and after the Contractor has received written approval of the specific test procedures.

- b. The COTR shall witness all testing and system adjustments during testing. Written permission shall be obtained from the Resident Engineer before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the Resident Engineer at the conclusion of each phase of testing and prior to Resident Engineer approval of the test.
 2. Test Procedures and Reports: The test procedures, compliant with VA standard test procedures, shall explain in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. The test reports shall be used to document results of the tests. The reports shall be delivered to the Resident Engineer within seven (7) calendar days after completion of each test.
- B. The inspection and test will be conducted by a factory-certified contractor representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by a designated 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.
- C. Contractor's Field Testing (CFT)
 1. The Contractor shall calibrate and test all equipment, verify DTM operation, place the integrated system in service, and test the integrated system. Ground rods installed by this Contractor within the base of camera poles shall be tested as specified in IEEE STD 142. The Contractor shall test all security systems and equipment, and provide written proof of a 100% operational system before a date is established for the system acceptance test. Documentation package for CFT shall include completed (fully annotated details of test details) for each device and system tested, and annotated loading sheets documenting complete testing to Resident Engineer approval. CFT test documentation package shall conform to submittal requirements outlined in this Section. The Contractor's field testing procedures shall be identical to the Resident Engineer's acceptance testing procedures. The Contractor shall provide the Resident Engineer with a written listing of all equipment and software indicating all equipment and components have been tested and passed. The Contractor shall deliver a written report to the Resident Engineer stating the installed complete system has been calibrated, tested, and is ready to begin performance verification testing; describing the results of the functional tests, diagnostics, and calibrations; and the report shall also include a copy of the approved acceptance test procedure. Performance

verification testing shall not take place until written notice by contractor is received certifying that a contractors field test was successful.

D. Performance Verification Test (PVT)

1. Test team:
 - a. After the system has been pretested and the Contractor has submitted the pretest results and certification to the Resident Engineer, then the Contractor shall schedule an acceptance test to date and give the Resident Engineer written, notice as described herein, prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a Government Representative, an OEM certified representative, representative of the Contractor and other approved by the Resident Engineer. The system shall be tested utilizing the approved test equipment to certify proof of performance, FCC, UL and Emergency Service 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 Contractor shall demonstrate the completed Physical Access Control System PACS complies with the contract requirements. In addition, the Contractor shall provide written certification that the system is 100% operational prior to establishing a date for starting PVT. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The PVT will be stopped and aborted as soon as 10 technical deficiencies are found requiring correction. The Contractor shall be responsible for all travel and lodging expenses incurred for out-of-town personnel required to be present for resumption of the PVT. If the acceptance test is aborted, the re-test will commence from the beginning with a retest of components previously tested and accepted.
3. The PVT, as specified, shall not begin until receipt of written certification that the Contractors Field Testing was successful. This shall include certification of successful completion of testing as specified in paragraph "Contractor's Field Testing", and upon successful completion of testing at any time when the system fails to perform as specified. Upon termination of testing by the Resident Engineer or Contractor, the Contractor shall commence an assessment period as described for Endurance Testing Phase II.
4. Upon successful completion of the acceptance test, the Contractor shall deliver test reports and other documentation, as specified, to the Resident Engineer prior to commencing the endurance test.

5. Additional Components of the PVT shall include:

a. System Inventory

- 1) All Device equipment
- 2) All Software
- 3) All Logon and Passwords
- 4) All Cabling System Matrices
- 5) All Cable Testing Documents
- 6) All System and Cabinet Keys

b. Inspection

- 1) Contractor shall record an inspection punch list noting all system deficiencies. The contractor shall prepare an inspection punch list format for Resident Engineers approval.
- 2) As a minimum the punch list shall include a listing of punch list items, punch list item location, description of item problem, date noted, date corrected, and details of how item was corrected.

6. Partial PVT - At the discretion of Resident engineer, the Performance Verification Test may be performed in part should a 100% compliant CFT be performed. In the event that a partial PVT will be performed instead of a complete PVT; the partial PVT shall be performed by testing 10% of the system. The contractor shall perform a test of each procedure on select devices or equipment.

E. Endurance Test

1. The Contractor shall demonstrate the specified probability of detection and false alarm rate requirements of the completed system. The endurance test shall be conducted in phases as specified below. The endurance test shall not be started until the Resident Engineer notifies the Contractor, in writing, that the performance verification test is satisfactorily completed, training as specified has been completed, and correction of all outstanding deficiencies has been satisfactorily completed. VA shall operate the system 24 hours per day, including weekends and holidays, during Phase I and Phase III endurance testing. VA will maintain a log of all system deficiencies. The Resident Engineer may terminate testing at any time the system fails to perform as specified. Upon termination of testing, the Contractor shall commence an assessment period as described for Phase II. During the last day of the test, the Contractor shall verify the appropriate operation of the system. Upon successful completion

of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Resident Engineer prior to acceptance of the system.

2. Phase I (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the Resident Engineer. If the system experiences no failures, the Contractor may proceed directly to Phase III testing after receiving written permission from the Resident Engineer.
3. Phase II (Assessment):
 - a. After the conclusion of Phase I, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Resident Engineer. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.
 - b. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Resident Engineer. The meeting shall not be scheduled earlier than five (5) business days after the Resident Engineer receives the report. As part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Resident Engineer will provide a written determination of either the restart date or require Phase I be repeated.
4. Phase III (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the COTR.
5. Phase IV (Assessment):
 1. After the conclusion of Phase III, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the COTR. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.

2. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the COTR. The meeting shall not be scheduled earlier than five (5) business days after receipt of the report by the COTR. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by repeating appropriate portions for the performance verification test. Based on the review meeting the test should not be scheduled earlier than five (5) business days after the Resident Engineer receives the report. As a part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by repeating appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Resident Engineer will provide a written determine of either the restart date or require Phase III be repeated. After the conclusion of any re-testing which the Resident Engineer may require, the Phase IV assessment shall be repeated as if Phase III had just been completed.

F. Exclusions

1. The Contractor will not be held responsible for failures in system performance resulting from the following:
 - a. An outage of the main power in excess of the capability of any backup power source provided the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the PACS performed as specified.
 - b. Failure of an Owner furnished equipment or communications link, provided the failure was not due to Contractor furnished equipment, installation, or software.
 - c. Failure of existing Owner owned equipment, provided the failure was not due to Contractor furnished equipment, installation, or software.

--- E N D ---

Table 1: Contractor Level of Effort

	Description of Tasks						
Description of Systems	Develop System Loading Sheets	Coordination	Initial Set-up Configuration	Graphic Maps	System Programming	Final Checks	Level of Effort (Typical Tasks)
SMS Setup and Configuration	e.g., program monitoring stations, programming networks, interconnections between CCTV, intercoms, time synchronization	e.g., retrieve IP addresses, naming conventions, standard event descriptions, programming templates, coordinate special system needs	e.g., Load system Operating System and Application software, general system configurations	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file	e.g., program monitoring stations, programming networks, interconnections between CCTV, intercoms, time synchronization	e.g., check all system diagnostics (e.g., clients, panels)	Load and set-up 4-6 CDs and configure servers (to configure Loading and Configuring software, Administrative account, audit log, Keystrokes, mouse clicks, multi-screen configuration
Electronic Entry Control Systems	e.g., setup of device, door groups and schedules, REX, Locks, link graphics	e.g., confirming device configurations, naming conventions, event description and narratives	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics		e.g., setup of device, door groups and schedules, REX, Locks, link graphics	e.g., performing entry testing to confirm correct set-up and configuration	e.g., creating a door, door configuration, adding request to exit, door monitors and relays, door timers, door related events (e.g., access, access denied, forced open, held open), linkages, controlled areas, advanced door monitoring, time zones, sequence of operations
Intrusion Detection Systems	e.g., enter door groups and schedules, link devices - REX, lock, and graphics	e.g., confirming device configurations, naming conventions, event description and narratives	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics		e.g., enter door groups and schedules, link devices - REX, lock, and graphics	e.g., walk test, device position, and masking	e.g., setting up monitoring and control points (e.g., motion sensors, glassbreaks, vibration sensor, strobes, sounders) creating intrusion zones, creating arm/disarm panel, timed sequences, time zones, icon placements on graphic maps, clearance levels, events (e.g., armed, disarmed, zone violation, device alarm activations), LCD reader messages
CCTV Systems	e.g., programming call-ups recording	e.g., confirming device configurations, naming conventions	e.g., enter data from loading sheets; camera naming convention, sequences, configure components)		e.g., programming call-ups recording	e.g., confirm area of coverage, call-up per event generated and recording rates	e.g., setting up cameras points, recording ratios (e.g., normal, alarm event) timed recording, linkages, maps placements, call-ups
Console Monitoring Components	N/A	per monitor	per monitor	per graphic map	N/A	per monitor	N/A
Note: Programming tasks are supported through the contractor's development of the Technical Data Package Submittals.							

SECTION 28 05 13
CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the finishing, installation, connection, testing and certification the conductors and cables required for a fully functional for electronic safety and security (ESS) system.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00, FIRESTOPPING. Requirements for firestopping application and use.
- C. Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.
- D. Section 28 05 26, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- E. Section 28 05 28.33, CONDUITS AND BACKBOXES FOR ELECTRONIC SECURITY AND SAFETY. Requirements for infrastructure.
- F. Section 31 20 00, EARTH MOVING. For excavation and backfill for cables that are installed in conduit.

1.3 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project's sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute's Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.4 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.

- C. IDC: Insulation displacement connector.
- D. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- F. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- G. RCDD: Registered Communications Distribution Designer.
- H. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
- I. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- J. UTP: Unshielded twisted pair.

1.5 QUALITY ASSURANCE

- A. See section 28 05 00, Paragraph 1.4.

1.6 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/COTR four copies of the certification that the material is in accordance with the drawings and specifications and diagrams for cable management system.
 - 3. Shop Drawings: Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
 - e. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.

4. Wiring Diagrams. Show typical wiring schematics including the following:
 - a. Workstation outlets, jacks, and jack assemblies.
 - b. Patch cords.
 - c. Patch panels.
5. Cable Administration Drawings: As specified in Part 3 "Identification" Article.
6. Project planning documents as specified in Part 3.
7. Maintenance Data: For wire and cable to include in maintenance manuals.

1.7 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. American Society of Testing Material (ASTM):
 - D2301.....Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape
- C. Federal Specifications (Fed. Spec.):
 - A-A-59544.....Cable and Wire, Electrical (Power, Fixed Installation)
- D. National Fire Protection Association (NFPA):
 - 70-11National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
 - 44Thermoset-Insulated Wires and Cables
 - 83Thermoplastic-Insulated Wires and Cables
 - 467Electrical Grounding and Bonding Equipment
 - 486A.....Wire Connectors and Soldering Lugs for Use with Copper Conductors
 - 486C.....Splicing Wire Connectors
 - 486D.....Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
 - 486E.....Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
 - 493Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
 - 514B.....Fittings for Cable and Conduit

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set or other pre-approved method.
 - 2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
 - 3. Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Support of Open Cabling: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- B. Cable Trays:
 - 1. Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick
 - 2. Ladder Cable Trays: Nominally 18 inches (455 mm) wide, and a rung spacing of 12 inches (305 mm).
- C. Conduit and Boxes: Comply with requirements in Section Section 28 05 28.33, CONDUITS AND BACKBOXES FOR ELECTRONIC SECURITY AND SAFETY.
 - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated and labeled, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Section 06 10 00, ROUGH CARPENTRY.

2.3 UTP CABLE

- A. Description: 100-ohm, 4-pair UTP, formed into 25-pair binder groups covered with a blue thermoplastic jacket.
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 - 3. Comply with TIA/EIA-568-B.2, Category 6.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG.
 - b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 - c. Communications, Riser Rated: Type CMR, complying with UL 1666.
 - d. Communications, Limited Purpose: Type CMX.
 - e. Multipurpose: Type MP or MPG.
 - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
 - g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.4 UTP CABLE HARDWARE

- A. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.
- B. Connecting Blocks: 110-style for Category 6. Provide blocks for the number of cables terminated on the block, plus 25percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.5 OPTICAL FIBER CABLE

- A. Description: Multimode, 62.5/125 micrometer, 24-fiber, nonconductive, tight buffer, optical fiber cable.
 - 1. Comply with ICEA S-83-596 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.3 for performance specifications.
 - 3. Comply with TIA/EIA-492AAAA-B for detailed specifications.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. General Purpose, Nonconductive: Type OFN or OFNG.
 - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
 - d. General Purpose, Conductive: Type OFC or OFCG.
 - e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
 - f. Riser Rated, Conductive: Type OFCR complying with UL 1666.
 5. Conductive cable shall be steel armored type.
 6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
 7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- B. Jacket:
1. Jacket Color: Orange for 62.5/125-micrometer cable.
 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.6 OPTICAL FIBER CABLE HARDWARE

- A. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
1. Quick-connect, simplex and duplex, Type ST connectors. Insertion loss shall be not more than 0.75 dB.
 2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 COAXIAL CABLE

- A. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- B. RG-11/U: NFPA 70, Type CATV.
1. No. 14AWG, solid, copper-covered steel conductor.
 2. Gas-injected, foam-PE insulation.
 3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
 4. Jacketed with sunlight-resistant, black PVC or PE.

5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.
- C. RG59/U: NFPA 70, Type CATVR.
1. No. 20 AWG, solid, silver-plated, copper-covered steel conductor.
 2. Gas-injected, foam-PE insulation.
 3. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip.
 4. Color-coded PVC jacket.
- D. RG-6/U: NFPA 70, Type CATV or CM.
1. No. 16AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
 2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
 3. Jacketed with black PVC or PE.
 4. Suitable for indoor installations.
- E. RG59/U: NFPA 70, Type CATV.
1. No. 20 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
 2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.
 3. PVC jacket.
- F. RG59/U (Plenum Rated): NFPA 70, Type CMP.
1. No. 20AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
 2. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.
 3. Copolymer jacket.
- G. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655, and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
1. CATV Cable: Type CATV, or CATVP or CATVR].
 2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
 3. CATV Riser Rated: Type CATVR or CATVP complying with UL 1666.
 4. CATV Limited Rating: Type CATVX.

2.8 COAXIAL CABLE HARDWARE

- A. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.9 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.10 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM or CMG.

1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.11 LOW-VOLTAGE CONTROL CABLE

A. Paired Lock Cable: NFPA 70, Type CMG.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.

2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with NFPA 262.
- C. Paired Lock Cable: NFPA 70, Type CMG.
1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with UL 1581.
- D. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
 2. Fluorinated ethylene propylene insulation.
 3. Unshielded.
 4. Plastic jacket.
 5. Flame Resistance: NFPA 262, Flame Test.

2.12 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.
- B. Class 2 Control Circuits: Stranded copper, power-limited cable, concealed in building finishes, power-limited tray cable, in cable tray complying with UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

2.13 FIRE ALARM WIRE AND CABLE

- A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

- B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
 - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum.
 - 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NRTL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

2.14 IDENTIFICATION PRODUCTS

- A. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.15 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

2.16 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.

2.17 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 OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Terminate all conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 9. Pulling Cable:
 - a. Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
 - b. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
 - c. Use ropes made of nonmetallic material for pulling feeders.

- d. 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/COTR.
 - e. Pull in multiple cables together in a single conduit.
- C. Splice cables and wires where necessary only in outlet boxes, junction boxes, or pull boxes.
 - 1. Splices and terminations shall be mechanically and electrically secure.
 - 2. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.
- D. 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.
- E. Unless otherwise specified in other sections install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- F. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- G. Where separate power supply circuits are not shown, connect the systems to the nearest panel boards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- H. 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.
- I. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.
- J. UTP Cable Installation:
 - 1. Comply with TIA/EIA-568-B.2.
 - 2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- K. Optical Fiber Cable Installation:
 - 1. Comply with TIA/EIA-568-B.3.
 - 2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.
- L. Open-Cable Installation:
 - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 - 2. Suspend copper cable not in a wire way or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

M. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 72 inches (1830 mm) long shall be neatly coiled not less than 12 inches (300 mm) in diameter below each feed point.

N. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

O. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.2 FIRE ALARM WIRING INSTALLATION

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal raceway according to Section 28 05 28.33, CONDUITS AND BACKBOXES FOR ELECTRICAL SYSTEMS.
 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
- C. Wiring Method:
 1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
 2. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is permitted.
 3. Signaling Line Circuits: Power-limited fire alarm cables maybe installed in the same cable or raceway as signaling line circuits where permitted by the system manufacturer.
- D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

- G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 CONTROL CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
 - 1. Class 1 remote-control and signal circuits, No. 14 AWG.
 - 2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
 - 3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.4 CONNECTIONS

- A. Comply with requirements in Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEM - EXTENSION for connecting, terminating, and identifying wires and cables.
- B. Comply with requirements in Section 28 16 11, INTRUSION DETECTION SYSTEM - EXTENSION for connecting, terminating, and identifying wires and cables.
- C. Comply with requirements in Section 28 23 00, VIDEO SURVEILLANCE SYSTEM - EXTENSION for connecting, terminating, and identifying wires and cables.
- D. Comply with requirements in Section 28 26 00, WIRELESS DURESS SYSTEM - EXTENSION for connecting, terminating, and identifying wires and cables.
- E. Comply with requirements in Section 28 31 00, FIRE DETECTION AND ALARM SYSTEM for connecting, terminating, and identifying wires and cables.

3.5 FIRESTOPPING

- A. Comply with requirements in Section 07 84 00, FIRESTOPPING.
- B. Comply with TIA/EIA-569-A, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Section 28 05 26, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY.

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.

- B. Install a permanent wire marker on each wire at each termination.
- C. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- D. Wire markers shall retain their markings after cleaning.
- E. In each handhole, install embossed brass tags to identify the system served and function.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - 4. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
 - 5. Coaxial Cable Tests: Comply with requirements in Section 27 41 41, MASTER ANENNA TELEVISION EQUIPMENT AND SYSTEMS – EXTENSION.

- D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.9 EXISTING 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.

--- E N D ---

SECTION 28 05 26
GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the finishing, installation, connection, testing and certification of the grounding and bonding required for a fully functional Electronic Safety and Security (ESS) system.
- B. “Grounding electrode system” refers to all electrodes required by NEC, as well as including made, supplementary, grounding electrodes.
- C. The terms “connect” and “bond” are used interchangeably in this specification and have the same meaning

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS: For General Requirements.
- B. Section 26 41 00, FACILITY LIGHTNING PROTECTION: Requirements for a lightning protection system.
- C. Section 28 05 00, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS: For general electrical requirements, quality assurance, coordination, and project conditions that are common to more than one section in Division 28.
- D. Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY: Requirements for low voltage power and lighting wiring.

1.3 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project’s sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute’s Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.4 SUBMITTALS

- A. Submit in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

- B. Shop Drawings:
 - 1. Clearly present enough information 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.
- 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 Resident Engineer:
 - 1. Certification that the materials and installation are in accordance with the drawings and specifications.
 - 2. Certification by the contractor that the complete installation has been properly installed and tested.

1.5 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. American Society for Testing and Materials (ASTM):
 - B1Standard Specification for Hard-Drawn Copper Wire
 - B3Standard Specification for Soft or Annealed Copper Wire
 - B8Standard Specification for Concentric-Lay-Stranded Copper
Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 81IEEE Guide for Measuring Earth Resistivity, Ground
Impedance, and Earth Surface Potentials of a Ground System
 - C2National Electrical Safety Code
- D. National Fire Protection Association (NFPA):
 - 70-11National Electrical Code (NEC)
 - 99Health Care Facilities

E. Underwriters Laboratories, Inc. (UL):

44	Thermoset-Insulated Wires and Cables
83	Thermoplastic-Insulated Wires and Cables
467	Grounding and Bonding Equipment
486A-486B	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.

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.

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. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- C. Below Grade: Exothermic-welded type connectors.
- D. Above Grade:
 - 1. Bonding Jumpers: Compression-type connectors, using zinc-plated fasteners and external tooth lockwashers.
 - 2. Connection to Building Steel: Exothermic-welded type connectors.
 - 3. Ground Busbars: Two-hole compression type lugs, using tin-plated copper or copper alloy bolts and nuts.
 - 4. Rack and Cabinet Ground Bars: One-hole compression-type lugs, using zinc-plated or copper alloy fasteners.
 - 5. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
 - a) Pipe Connectors: Clamp type, sized for pipe.

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

2.4 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 3/4 inch).

2.5 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.

2.6 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.

2.7 COMPUTER ROOM GROUND

- A. Provide 50mm² (1/0 AWG) bare copper grounding conductors bolted at mesh intersections to form an equipotential grounding grid. The equipotential grounding grid shall form a 600mm (24 inch) mesh pattern. The grid shall be bonded to each of the access floor pedestals.

2.8 SECURITY CONTROL CONSOLE GROUND

- A. Provide 50mm² (1/0 AWG) stranded copper grounding conductor(s) color coded with a green jacket, bolted at the Room's Communications System Grounding Electrode Cooper Plate and circulate to each equipment rack ground buss bar through the wire management system. Connect each equipment rack, wire management system's cable tray, ladder, etc. to the circulating ground wire with a minimum 25mm² (4AWG) stranded Cooper Wire, color coded with a green jacket.
 1. Connect each equipment rack ground buss bar to the circulating ground wire as indicated in 2.9.A.
 2. Connect each additional room item to the circulating ground wire as indicated in 2.9.A.

PART 3 - EXECUTION

3.1 GENERAL

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

- 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 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.

3.4 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.

3.5 COMPUTER ROOM/SECURITY CONSOLE GROUNDING

- A. Conduit: Ground and bond metallic conduit systems as follows:
 - 1. Ground metallic service conduit and any pipes entering or being routed within the computer room at each end using 16 mm² (6AWG) bonding jumpers.
 - 2. Bond at all intermediate metallic enclosures and across all joints using 16 mm² (6 AWG) bonding jumpers.

3.6 WIREWAY GROUNDING

- A. Ground and Bond Metallic Wireway Systems as follows:
 - 1. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 16 mm² (6 AWG) bonding jumper at all intermediate metallic enclosures and across all section junctions.
 - 2. Install insulated 16 mm² (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
 - 3. Use insulated 16 mm² (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.
 - 4. 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 15 meters.

3.7 LIGHTNING PROTECTION SYSTEM

- A. Bond the lightning protection system to earth ground externally to the building. Under no condition shall the electrical system's third or fourth ground electrode system, or the telecommunications system circulating ground system be connected to the lightning protection system. The Facility's structural steel may be used to connect the lightning protection system at the direction of the Resident Engineer certified by an independent certified grounding contractor.

3.8 EXTERIOR LIGHT/CAMERA POLES

- A. Provide 20 ft of No. 4 bare copper coiled at bottom of pole base excavation prior to pour, plus additional unspliced length in and above foundation as required to reach pole ground stud.

3.9 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure 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 fewer 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.

3.10 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.

3.11 GROUNDING FOR RF/EMI CONTROL

- A. Install bonding jumpers to bond all conduit, cable trays, sleeves and equipment for low voltage signaling and data communications circuits. Bonding jumpers shall consist of 100 mm (4 inches) wide copper strip or two 6 mm² (10 AWG) copper conductors spaced minimum 100 mm (4 inches) apart. Use 16 mm² (6 AWG) copper where exposed and subject to damage.
- B. Comply with the following when shielded cable is used for data circuits.
 - 1. Shields shall be continuous throughout each circuit.
 - 2. Connect shield drain wires together at each circuit connection point and insulate from ground. Do not ground the shield.
 - 3. Do not connect shields from different circuits together.
 - 4. Shield shall be connected at one end only. Connect shield to signal reference at the origin of the circuit. Consult with equipment manufacturer to determine signal reference.

3.12 LABELING

- A. Comply with requirements in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATION, Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
 - 1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.13 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.

- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
 - 1. Power Distribution Units or Panel boards Serving Electronic Equipment: 3 ohm(s).
 - 2. Manhole Grounds: 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

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SECTION 28 05 28.33
CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the finishing, installation, connection, testing certification of the conduit, fittings, and boxes to form a complete, coordinated, raceway system(s). Conduits and when approved separate UL Certified and Listed partitioned telecommunications raceways are required for a fully functional Electronic Safety and Security (ESS) system. Raceways are required for all electronic safety and security cabling unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS: For General Requirements.
- B. Section 06 10 00, ROUGH CARPENTRY: Requirements for mounting board for communication closets.
- C. Section 07 84 00, FIRESTOPPING: Requirements for sealing around penetrations to maintain the integrity of fire rated construction.
- D. Section 07 60 00, FLASHING AND SHEET METAL: Requirements for fabrications for the deflection of water away from the building envelope at penetrations.
- E. Section 07 92 00, JOINT SEALANTS: Requirements for sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.
- F. Section 09 91 00, PAINTING: Requirements for identification and painting of conduit and other devices.
- G. Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY: For general electrical requirements, general arrangement of the contract documents, coordination, quality assurance, project conditions, equipment and materials, and items that is common to more than one section of Division 28.
- H. Section 28 05 26, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- I. Section 31 20 00 - EARTH MOVING: For bedding of conduits.

1.3 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project's sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute's Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.4 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

1.5 QUALITY ASSURANCE

- A. Refer to Paragraph 1.4 Quality Assurance, in Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

1.6 SUBMITTALS

- A. Submit in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:
 - 1. Size and location of main feeders;
 - 2. Size and location of panels and pull boxes
 - 3. Layout of required conduit penetrations through structural elements.
 - 4. The specific item proposed and its area of application shall be identified on the catalog cuts.

- C. Certification: Prior to final inspection, deliver to the Resident Engineer/COTR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.
- D. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- E. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.
- F. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in the paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- G. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces. Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- H. Source quality-control test reports.

1.7 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 Electrical Manufacturers Association (NEMA):
- TC-3PVC Fittings for Use with Rigid PVC Conduit and Tubing
- FB1.....Fittings, Cast Metal Boxes and Conduit Bodies for Conduit,
Electrical Metallic Tubing and Cable
- C. National Fire Protection Association (NFPA):
- 70-11National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
- 1Flexible Metal Conduit
- 5Surface Metal Raceway and Fittings
- 6Rigid Metal Conduit
- 50Enclosures for Electrical Equipment
- 360Liquid-Tight Flexible Steel Conduit
- 467Grounding and Bonding Equipment
- 514A.....Metallic Outlet Boxes
- 514B.....Fittings for Cable and Conduit
- 514C.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
- 651Schedule 40 and 80 Rigid PVC Conduit
- 651A.....Type EB and A Rigid PVC Conduit and HDPE Conduit
- 797Electrical Metallic Tubing
- 1242Intermediate Metal Conduit

PART 2 - PRODUCTS

2.1 GENERAL

- A. Conduit Size: In accordance with the NEC, but not less than 20 mm (3/4 inch) unless otherwise shown.

2.2. CONDUIT

- A. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
- B. Rigid aluminum: Shall Conform to UL 6A, ANSI C80.5.
- C. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.

- D. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 volts or less.
- E. Flexible galvanized steel conduit: Shall Conform to UL 1.
- F. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
- G. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).

2.3. WIREWAYS AND RACEWAYS

- A. Surface metal raceway: Shall Conform to UL 5.

2.4. CONDUIT FITTINGS

- A. Rigid steel and IMC conduit fittings:
 - 1. Fittings shall meet the requirements of UL 514B and ANSI/NEMA FB1.
 - 2. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - 3. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
 - 4. 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.
 - 5. 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.
 - 6. 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.
- B. Rigid aluminum conduit fittings:
 - 1. 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.
 - 2. Locknuts and bushings: As specified for rigid steel and IMC conduit.
 - 3. Set screw fittings: Not permitted for use with aluminum conduit.
- C. Electrical metallic tubing fittings:
 - 1. Fittings shall meet the requirements of UL 514B and ANSI/NEMA FB1.
 - 2. Only steel or malleable iron materials are acceptable.

3. 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.
 4. Indent type connectors or couplings are prohibited.
 5. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
- D. Flexible steel conduit fittings:
1. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
 2. Clamp type, with insulated throat.
- E. Liquid-tight flexible metal conduit fittings:
1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 2. Only steel or malleable iron materials are acceptable.
 3. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
- F. Direct burial plastic conduit fittings:
1. Fittings shall meet the requirements of UL 514C and NEMA TC3.
 2. As recommended by the conduit manufacturer.
- G. Surface metal raceway fittings: As recommended by the raceway manufacturer.
- H. Expansion and deflection couplings:
1. Conform to UL 467 and UL 514B.
 2. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
 3. 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.
 4. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

2.5 CONDUIT SUPPORTS

- A. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
- B. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.

- C. 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.
- D. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

2.6 OUTLET, JUNCTION, AND PULL BOXES

- A. UL-50 and UL-514A.
- B. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- D. Metal Floor Boxes: Cast or sheet metal, semi-adjustable, rectangular.
- E. Sheet metal boxes: Galvanized steel, except where otherwise shown.
- F. 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.

2.7 CABINETS

- A. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
- B. Hinged door in front cover with flush latch and concealed hinge.
- C. Key latch to match panelboards.
- D. Metal barriers to separate wiring of different systems and voltage.
- E. Accessory feet where required for freestanding equipment.

2.8 WIREWAYS

- A. Equip with hinged covers, except where removable covers are shown.

2.9 WARNING TAPE

- A. Standard, 4-Mil polyethylene 76 mm (3 inches) wide tape non-detectable type, red with black letters, and imprinted with "CAUTION BURIED ELECTRONIC SAFETY AND SECURITY CABLE BELOW".

2.10 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
 - 1. Color of Frame and Cover: Gray.
 - 2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.

3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 5. Cover Legend: Molded lettering, as indicated for each service.
 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 7. Handholes 300 mm wide by 600 mm long (2 inches wide by 24 inches long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

2.11 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 07 84 00, FIRESTOPPING.

2.12 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.13 GROUT

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

PART 3 - EXECUTION

3.1 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 Resident Engineer/COTR 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 Resident Engineer/COTR as required by limited working space.

B. Fire Stop: Where conduits, wireways, and other electronic safety and security 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. 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 square with a hacksaw, ream, remove burrs, and draw up tight.
5. Mechanically continuous.
6. Independently support conduit at 2.4 m (8 foot) 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 (12 inches) of changes of direction, and within 300 mm (12 inches) 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.
- C. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown.
 2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the Resident Engineer/COTR.
- D. Fire Alarm:
1. Fire alarm conduit shall be painted red (a red “top-coated” conduit from the conduit manufacturer may be used in lieu of painted conduit) in accordance with the requirements of Section 28 31 00, FIRE DETECTION AND ALARM SYSTEM.

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/COTR 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 inch) 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 above 600 volts:
 - a. Rigid steel or rigid aluminum.
 - b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
 - 2. 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.
 - 3. Align and run conduit parallel or perpendicular to the building lines.
 - 4. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (6 feet) of flexible metal conduit extending from a junction box to the fixture.
 - 5. 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. 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.
- C. Align and run conduit parallel or perpendicular to the building lines.
- D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- E. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.
- F. Surface metal raceways: Use only where shown.
- G. Painting:
 - 1. Paint exposed conduit as specified in Section 09 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. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes).
- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches) deep, with device covers for the wall material and thickness involved.
- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".

- G. On all Branch Circuit junction box covers, identify the circuits with black marker.

3.8 ELECTRONIC SAFETY AND SECURITY CONDUIT

- A. Install the electronic safety and security raceway system as shown on drawings.
- B. Minimum conduit size of 19 mm (3/4 inch), but not less than the size shown on the drawings.
- C. All conduit ends shall be equipped with insulated bushings.
- D. All 100 mm (four inch) conduits within buildings shall include pull boxes after every two 90 degree bends. Size boxes per the NEC.
- E. Vertical conduits/sleeves through closets floors 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.
- H. All empty conduits located in communications 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 four quarter turns (90 degree bends) between pull boxes/backboards. Minimum radius of communication conduit bends shall be as follows (special long radius):

Sizes of Conduit Trade Size	Radius of Conduit Bends mm, Inches
3/4	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

- J. Furnish and install 19 mm (3/4 inch) thick fire retardant plywood specified in 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).

--- E N D ---

SECTION 28 13 00

PHYSICAL ACCESS CONTROL SYSTEM – EXTENSION

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, testing and certification of a complete and fully operating expansion to the existing Hirsch Physical Access Control System, hereinafter referred to as the PACS.
- B. The PACS expansion for this project shall provide, as a minimum, the same hardware, software, programming, operational features, communications features and security features as provided in the existing system.
- C. System Architecture:
 - 1. Contractor shall provide all hardware, software, firmware, programming, conductors, power, labor and all other items and appurtenances required for a completely operational and acceptable expansion to the existing Hirsch PACS system.
 - 2. Contractor shall be responsible to coordinate with the Fire Detection and Alarm Contractor to integrate the PACS to the Fire Detection and Alarm system to provide egress as required by all applicable codes.
- D. PACS shall provide secure and reliable identification of Federal employees and contractors by utilizing credential authentication per FIPS-201.
- E. Physical Access Control System (PACS) shall consist of:
 - 1. Field installed controllers
 - 2. Card readers
 - 3. Supportive information system
 - 4. Door locks and sensors
 - 5. Request-to-exit devices
 - 6. Emergency request-to-exit devices
 - 7. Power supplies
 - 8. Interfaces with: Fire Protection System
 - 9. All additional accessories and appurtenances, as required
- F. Head-End equipment server, workstations and controllers shall be connected by a high-speed electronic data transmission network.

- G. Information system supporting PACS , Head-End equipment server, workstations, network switches, routers and controllers shall comply with FIPS 200 requirements (Minimum Security Requirements for Federal Information and Information Systems)and NIST Special Publication 800-53 (Recommended Security Controls for Federal Information Systems).
- H. PACS system shall support:
1. Multiple credential authentication modes
 2. Bidirectional communication with the reader
 3. Incident response policy implementation capability; system shall have capability to automatically change access privileges for certain user groups to high security areas in case of incident/emergency.
 4. Visitor management
- I. All security relevant decisions shall be made on “secure side of the door”. Secure side processing shall include;
1. Challenge/response management
 2. PKI path discovery and validation
 3. Credential identifier processing
 4. Authorization decisions
- J. For locations where secure side processing is not applicable the tamper switches and certified cryptographic processing shall be provided per FIPS-140-2.
- K. System Software: Based on existing Hirsch central-station, workstation operating system, server operating system, and application software.
- L. Software and controllers shall be capable of matching full 56 bit FASC-N plus minimum of 32 bits of public key certificate data.
- M. Software shall have the following capabilities:
1. Multiuser multitasking to allow for independent activities and monitoring to occur simultaneously at different workstations.
 2. Support authentication and enrolment;
 - a. PIV verification,
 - b. Expiration date check,
 - c. Biometric check,
 - d. Digital photo display/check,
 - e. Validate digital signatures of data objects (Objects are signed by the Trusted Authority
 - f. Private key challenge (CAK and PAK to verify private key public key pairs exist and card is not a clone)

3. Support CRL validation via OCSP or SCVP on a scheduled basis and automatically deny access to any revoked credential in the system.
4. Graphical user interface to show pull-down menus and a menu tree format that complies with interface guidelines of Microsoft Windows operating system.
5. System license shall be for the entire system and shall include capability for future additions that are within the indicated system size limits specified in this Section.
6. System shall have open architecture that allows importing and exporting of data and interfacing with other systems that are compatible with existing Hirsch operating system.
7. Operator login and access shall be utilized via integrated smart card reader and password protection.

N. Systems Networks:

1. A standalone system network shall interconnect all components of the system. This network shall include communications between a central station and any peer or subordinate workstations, enrollment stations, local annunciation stations, portal control stations or redundant central stations.

O. Number of points:

1. PACS shall support multiple autonomous regional servers that can connect to a master command and controller server.
2. Unlimited number of access control readers, unlimited number of inputs or outputs, unlimited number of client workstations, unlimited number of cardholders.
3. Total system solution to enable enterprise-wide, networked, multi-user access to all system resources via a wide range of options for connectivity with the customer's existing LAN and WAN.

P. Console Network:

1. Console network, if required, shall provide communication between a central station and any subordinate or separate stations of the system. Where redundant central or parallel stations are required, the console network shall allow the configuration of stations as master and slave. The console network may be a part of the field device network or may be separate depending upon the manufacturer's system configuration.

Q. Network(s) connecting PCs and Controllers shall comply with NIST Special Publication 800-53 (Recommended Security Controls for Federal Information Systems) and consist of one or more of the following:

1. Local area, IEEE 802.3 Fast Ethernet 10 BASE-T star topology network based on TCP/IP.

2. Direct-connected, RS-232 cable from the COM port of the Central Station to the first Controller, then RS-485 to interconnect the remainder of the Controllers at that Location.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS: For General Requirements.
- B. Section 07 84 00, FIRESTOPPING: Requirements for firestopping application and use.
- C. Section 08 71 00, DOOR HARDWARE: Requirements for door installation.
- D. Section 10 14 00, SIGNAGE: Requirements for labeling and signs.
- E. Section 14 21 00, ELECTRIC TRACTION ELEVATORS: Requirements for elevators.
- F. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements for connection of high voltage.
- G. Section 26 05 21, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Requirements for power cables.
- H. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS: Requirements for infrastructure.
- I. Section 26 05 41 - UNDERGROUND ELECTRICAL CONSTRUCTION: Requirements for underground installation of wiring.
- J. Section 26 56 00, EXTERIOR LIGHTING: Requirements for perimeter lighting.
- K. Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY: For general requirements that are common to more than one section in Division 28.
- L. Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY: Requirements for conductors and cables.
- M. Section 28 05 26, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY: Requirements for grounding of equipment.
- N. Section 28 05 28.33, CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY: Requirements for infrastructure.
- O. Section 28 16 11, INTRUSION DETECTION SYSTEM: Requirements for alarm systems.
- P. Section 28 26 00, WIRELESS DURESS SYSTEM – EXTENSION: Requirements for emergency and interior communications.

1.3 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project's sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute's Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.4 QUALITY ASSURANCE

- A. Refer to 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- B. The Contractor shall be responsible for providing, installing, and the operation of the PACS as shown. The Contractor shall also provide certification as required.
- C. The security system will be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- D. 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.
- E. Product Qualifications:
 - 1. This project is an expansion to an existing Hirsch system.
 - 2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

F. Contractor Qualifications:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (PACS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The Resident Engineer reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.
 - a. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
 - b. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.

- G. 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.

1.5 SUBMITTALS

- A. Refer to 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- B. Submit below items in conjunction with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES and Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- C. Provide certificates of compliance with Section 1.3, Quality Assurance.
- D. Provide a complete and thorough pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (1220 x 1220 millimeters); drawing submittals shall be per the established project schedule.
- E. Shop drawing and as-built packages shall include, but not be limited to:
 - 1. Index Sheet that shall:
 - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
 - b. Provide a complete list of all security abbreviations and symbols.
 - c. Reference all general notes that are utilized within the design package.
 - d. Specification and scope of work pages for all individual security systems that are applicable to the design package that will:
 - 1) Outline all general and job specific work required within the design package.
 - 2) Provide a detailed device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
 - 2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
 - a. Include a title block as defined above.
 - b. Clearly define the drawings scale in both standard and metric measurements.
 - c. Provide device identification and location.
 - d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
 - e. Identify all pull box and conduit locations, sizes, and fill capacities.
 - f. Address all general and drawing specific notes for a particular drawing sheet.
 - 3. A detailed riser drawing for each applicable security subsystem shall:
 - a. Indicate the sequence of operation.
 - b. Relationship of integrated components on one diagram.
 - c. Include the number, size, identification, and maximum lengths of interconnecting wires.

- d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
 - 4. A detailed system drawing for each applicable security system shall:
 - a. Clearly identify how all equipment within the system, from main panel to device, shall be laid out and connected.
 - b. Provide full detail of all system components wiring from point-to-point.
 - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
 - d. Show device locations that correspond to the floor plans.
 - e. All general and drawing specific notes shall be included with the system drawings.
 - 5. A detailed schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
 - a. Device ID.
 - b. Device Location (e.g. site, building, floor, room number, location, and description).
 - c. Mounting type (e.g. flush, wall, surface, etc.).
 - d. Power supply or circuit breaker and power panel number.
 - e. In addition, for the PACS, provide the door ID, door type (e.g. wood or metal), locking mechanism (e.g. strike or electromagnetic lock) and control device (e.g. card reader or biometrics).
 - 6. Detail and elevation drawings for all devices that define how they were installed and mounted.
- F. Pre-installation design packages shall go through a full review process conducted by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
- 1. 35 percent
 - 2. 65 percent
 - 3. 90 percent
 - 4. 100 percent

- G. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
- H. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS, and Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- I. General: Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breadth or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. Additional general provisions are as follows:
1. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination drawings refer to Section 01 33 00, SUBMITTAL PROCEDURES, which outline basic submittal requirements and coordination. Section 01 33 00, SUBMITTAL PROCEDURES, shall be used in conjunction with this section.
 2. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
 3. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
 4. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for Resident Engineer and Contractor review stamps.

5. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with VA CAD Standards. **FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED.** The Contractor shall not reproduce Contract Documents or copy standard information as the basis of the Technical Data Drawings. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the Resident Engineer for approval before the initiation of work.
6. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
 - a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
 - 1) Where two (2) or more binders are necessary to accommodate data, correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-referencing other binders where necessary to provide essential information for communication of proper operation and or maintenance of the component or system.
 - 2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.
 - b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
 - c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
 - d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.
 - e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.
 - 1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.

- 2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.
 - 3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16" tall.
- f. Manual Content: In each manual include information specified in the individual Specification section, and the following information for each major component of building equipment and controls:
- 1) General system or equipment description.
 - 2) Design factors and assumptions.
 - 3) Copies of applicable Shop Drawings and Product Data.
 - 4) System or equipment identification including: manufacturer, model and serial numbers of each component, operating instructions, emergency instructions, wiring diagrams, inspection and test procedures, maintenance procedures and schedules, precautions against improper use and maintenance, repair instructions, sources of required maintenance materials and related services, and a manual index.
- g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.
- h. Title Page: Provide a title page as the first sheet of each manual to include the following information; project name and address, subject matter covered by the manual, name and address of the Project, date of the submittal, name, address, and telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.
- i. Table of Contents: After the title page, include a type written table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.

- j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.
- k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems, or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.
- l. Manufacturer's Data: Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.
- m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual, prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.
- n. Calculations: Provide a section for circuit and panel calculations.
- o. Loading Sheets: Provide a section for DGP Loading Sheets.
- p. Certifications: Provide section for Contractor's manufacturer certifications.
- 7. Contractor Review: Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer's catalog numbers and conformance of submittal with requirements of contract documents. Return non-conforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor's stamp with signature certifying the review and verification of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.

8. Resubmission: Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under procedures specified for initial submittals. Identify all changes made since previous submittal.
9. Product Data: Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.
- J. Group I Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. Refer to VA Special Conditions Document for drawing format and content requirements. The data package shall include the following:
 1. Section I - Drawings:
 - a. General – Drawings shall conform to VA Special Conditions and CAD Standards Documents. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings.
 - b. Cover Sheet – Cover sheet shall consist of Project Title and Address, Project Number, Area and Vicinity Maps.
 - c. General Information Sheets – General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Wire and Cable Schedule, Project Phasing, and Sheet Index.
 - d. Floor Plans – Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings. Floor plans shall identify the following:
 - 1) security devices by symbol,
 - 2) the associated device point number (derived from the loading sheets),
 - 3) wire and cable types and counts
 - 4) conduit sizing and routing
 - 5) conduit riser systems
 - 6) device and area detail call outs
 - e. Architectural details – Architectural details shall be produced for each device mounting type (door details for doors with physical access control, reader pedestals and mounts, security panel and power supply details).

- f. Riser Diagrams – Contractor shall provide a riser diagram indicating riser architecture and distribution of the physical access control system throughout the facility (or area in scope).
- g. Block Diagrams – Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., physical access control, intrusion detection, closed circuit television, intercom, and other associated subsystems) integration; and data transmission and media conversion methodologies.
- h. Interconnection Diagrams – Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule. Diagram shall also identify interfaces to other systems such as elevator control, fire alarm systems, and security management systems.
- i. Security Details:
 - 1) Panel Assembly Detail – For each panel assembly, a panel assembly details shall be provided identifying individual panel component size and content.
 - 2) Panel Details – Provide security panel details identify general arrangement of the security system components, backboard size, wire through size and location, and power circuit requirements.
 - 3) Device Mounting Details – Provide mounting detailed drawing for each security device (physical access control system, intrusion detection, video surveillance and assessment, and intercom systems) for each type of wall and ceiling configuration in project. Device details shall include device, mounting detail, wiring and conduit routing.
 - 4) Details of connections to power supplies and grounding
 - 5) Details of surge protection device installation
 - 6) Sensor detection patterns – Each system sensor shall have associated detection patterns.
 - 7) Equipment Rack Detail – For each equipment rack, provide a scaled detail of the equipment rack location and rack space utilization. Use of BISCII wire management standards shall be employed to identify wire management methodology. Transitions between equipment racks shall be shown to include use vertical and horizontal latter rack system.

- 8) Operator Console – The contractor shall provide a layout plan for the Operator Console. The layout plan shall identify all equipment and details associated with the installation.
- j. Electrical Panel Schedule – Electrical Panel Details shall be provided for all SMS systems electrical power circuits. Panel details shall be provided identifying panel type (Standard, Emergency Power, Emergency/Uninterrupted Power Source, and Uninterrupted Power Source Only), panel location, circuit number, and circuit amperage rating.
- k. Door Schedule – A door schedule shall be developed for each door equipped with electronic security components. At a minimum, the door schedule shall be coordinated with Division 08 work and include the following information:
 - 1) Item Number
 - 2) Door Number (Derived from A/E Drawings)
 - 3) Floor Plan Sheet Number
 - 4) Standard Detail Number
 - 5) Door Description (Derived from Loading Sheets)
 - 6) Data Gathering Panel Input Number
 - 7) Door Position or Monitoring Device Type and Model Number
 - 8) Lock Type, Model Number and Power Input/Draw (standby/active)
 - 9) Card Reader Type and Model Number
 - 10) Shunting Device Type and Model Number
 - 11) Sounder Type and Model Number
 - 12) Manufacturer
 - 13) Misc. devices as required
 - a) Delayed Egress Type and Model Number
 - b) Electric Transfer Hinge
 - c) Electric Pass-through device
 - 14) Remarks column indicating special notes or door configurations
2. Section II – Data Gathering Panel Documentation Package
 - a. Contractor shall provide Data Gathering Panel (DGP) input and output documentation packages for review at the Shop Drawing submittal stage and also with the as-built documentation package. The documentation packages shall be provided in both printed and magnetic form at both review stages.

- b. The Contractor shall provide loading sheet documentation package for the associated DGP, including input and output boards for all field panels associated with the project. Documentation shall be provided in current version Microsoft Excel spreadsheets following the format currently utilized by VA. A separate spreadsheet file shall be generated for each DGP and associated field panels.
- c. The spreadsheet names shall follow a sequence that shall display the spreadsheets in numerical order according to the DGP system number. The spreadsheet shall include the prefix in the file name that uniquely identifies the project site. The spreadsheet shall detail all connected items such as card readers, alarm inputs, and relay output connections. The spreadsheet shall include an individual section (row) for each panel input, output and card reader. The spreadsheet shall automatically calculate the system numbers for card readers, inputs, and outputs based upon data entered in initialization fields.
- d. All entries must be verified against the field devices. Copies of the floor plans shall be forwarded under separate cover.
- e. The DGP spreadsheet shall include an entry section for the following information:
 - 1) DGP number
 - 2) First Reader Number
 - 3) First Monitor Point Number
 - 4) First Relay Number
 - 5) DGP, input or output Location
 - 6) DGP Chain Number
 - 7) DGP Cabinet Tamper Input Number
 - 8) DGP Power Fail Input Number
 - 9) Number of Monitor Points Reserved For Expansion Boards
 - 10) Number of Control Points (Relays) Reserved For Expansion Boards
- f. The DGP, input module and output module spreadsheets shall automatically calculate the following information based upon the associated entries in the above fields:
 - 1) System Numbers for Card Readers
 - 2) System Numbers for Monitor Point Inputs
 - 3) System Numbers for Control Points (Relays)
 - 4) Next DGP or input module First Monitor Point Number
 - 5) Next DGP or output module First Control Point Number

- g. The DGP spreadsheet shall provide the following information for each card reader:
 - 1) DGP Reader Number
 - 2) System Reader Number
 - 3) Cable ID Number
 - 4) Description Field (Room Number)
 - 5) Description Field (Device Type i.e.: In Reader, Out Reader, etc.)
 - 6) Description Field
 - 7) DGP Input Location
 - 8) Date Test
 - 9) Date Passed
 - 10) Cable Type
- h. The DGP and input module spreadsheet shall provide the following information for each monitor point (alarm input).
 - 1) DGP Monitor Point Input Number
 - 2) System Monitor Point Number
 - 3) Cable ID Number
 - 4) Description Field (Room Number)
 - 5) Description Field (Device Type i.e.: Door Contact, Motion Detector, etc.)
 - 6) DGP or input module Input Location
 - 7) Date Test
 - 8) Date Passed
 - 9) Cable Type
- i. The DGP and output module spreadsheet shall provide the following information for each control point (output relay).
 - 1) DGP Control Point (Relay) Number
 - 2) System (Control Point) Number
 - 3) Cable ID Number
 - 4) Description Field (Room Number)
 - 5) Description Field (Device: Lock Control, Local Sounder, etc.)
 - 6) Description Field
 - 7) DGP or OUTPUT MODULE Output Location
 - 8) Date Test
 - 9) Date Passed Cable Type

- j. The DGP, input module and output module spreadsheet shall include the following information or directions in the header and footer:
- 1) Header
 - a) DGP Input and Output Worksheet
 - b) Enter Beginning Reader, Input, and Output Starting Numbers and Sheet Will Automatically Calculate the Remaining System Numbers.
 - 2) Footer
 - a) File Name
 - b) Date Printed
 - c) Page Number
3. Section III - Manufacturers' Data: The data package shall include manufacturers' data for all materials and equipment, including sensors, local processors and console equipment provided under this specification.
4. Section IV - System Description and Analysis: The data package shall include system descriptions, analysis, and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance requirements of this specification. The data package shall include the following:
- a. Central processor memory size; communication speed and protocol description; rigid disk system size and configuration; flexible disk system size and configuration; back-up media size and configuration; alarm response time calculations; command response time calculations; start-up operations; expansion capability and method of implementation; sample copy of each report specified; and color photographs representative of typical graphics.
 - b. Software Data: The data package shall consist of descriptions of the operation and capability of the system, and application software as specified.
 - c. Overall System Reliability Calculations: The data package shall include all manufacturers' reliability data and calculations required to show compliance with the specified reliability.
5. Section V – Certifications & References: All specified manufacturer's certifications shall be included with the data package. Contractor shall provide Project references as outlined in Paragraph 1.4 "Quality Assurance".

K. Group II Technical Data Package

1. The Contractor shall prepare a report of “Current Site Conditions” and submit a report to the Resident Engineer documenting changes to the site, particularly those conditions that affect performance of the system to be installed. The Contractor shall provide specification sheets, or written functional requirements to support the findings, and a cost estimate to correct those site changes or conditions which affect the installation of the system or its performance. The Contractor shall not correct any deficiency without written permission from the COTR.
2. System Configuration and Functionality: The contractor shall provide the results of the meeting with VA to develop system requirements and functionality including but not limited to:
 - a. Baseline configuration
 - b. Access levels
 - c. Schedules (intrusion detection, physical access control, holidays, etc.)
 - d. Badge database
 - e. System monitoring and reporting (unit level and central control)
 - f. Naming conventions and descriptors

L. Group III Technical Data Package

1. Development of Test Procedures: The Contractor will prepare performance test procedures for the system testing. The test procedures shall follow the format of the VA Testing procedures and be customized to the contract requirements. The Contractor will deliver the test procedures to the Resident Engineer for approval at least 60 calendar days prior to the requested test date.

M. Group IV Technical Data Package

1. Performance Verification Test
 - a. Based on the successful completion of the pre-delivery test, the Contractor shall finalize the test procedures and report forms for the performance verification test (PVT) and the endurance test. The PVT shall follow the format, layout and content of the pre-delivery test. The Contractor shall deliver the PVT and endurance test procedures to the Resident Engineer for approval. The Contractor may schedule the PVT after receiving written approval of the test procedures. The Contractor shall deliver the final PVT and endurance test reports within 14 calendar days from completion of the tests. Refer to Part 3 of this section for System Testing and Acceptance requirements.

2. Training Documentation
 - a. New Facilities and Major Renovations: Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for VA technicians and administrative personnel. Training shall include general information on new system layout including closet locations, turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided.
3. System Configuration and Data Entry:
 - a. The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., video matrix switch, intercom, digital video recorders, and network video recorders). All data entry shall be performed per VA standards and guidelines. The Contractor is responsible for participating in all meetings with the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated in to the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, and program and/or configure the following components:
 - 1) Physical Access control system components,
 - 2) All intrusion detection system components,
 - 3) Video surveillance, control and recording systems,
 - 4) Intercom systems components,
 - 5) All other security subsystems shown in the contract documents.
 - b. The Contractor is responsible for compiling the card access database for the VA employees, including programming reader configurations, access shifts, schedules, exceptions, card classes and card enrollment databases.
 - c. Refer to Part 3 for system programming requirements and planning guidelines.

4. Graphics: Based on CAD as-built drawings developed for the construction project, create all map sets showing locations of all alarms and field devices. Graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points shall be delivered with the system. The Contractor shall create and install all graphics needed to make the system operational. The Contractor shall utilize data from the contract documents, Contractor's field surveys, and all other pertinent information in the Contractor's possession to complete the graphics. The Contractor shall identify and request from the COTR, any additional data needed to provide a complete graphics package. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 203.2 x 254 mm (8 x 10 in) of each type of graphic to be used for the completed Security system. The graphics examples shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.
- N. Group V Technical Data Package: Final copies of the manuals shall be delivered to the Resident Engineer as part of the acceptance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each sub-contractor installing equipment or systems, as well as the nearest service representatives for each item of equipment for each system. The manuals shall include a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. Six (6) hard-copies and one (1) soft copy on CD of each item listed below shall be delivered as a part of final systems acceptance.
1. Functional Design Manual: The functional design manual shall identify the operational requirements for the entire system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes. Manufacturer developed literature may be used; however, shall be produced to match the project requirements.
 2. Equipment Manual: A manual describing all equipment furnished including:
 - a. General description and specifications; installation and checkout procedures; equipment electrical schematics and layout drawings; system schematics and layout drawings; alignment and calibration procedures; manufacturer's repair list indicating sources of supply; and interface definition.

3. Software Manual: The software manual shall describe the functions of all software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
 - a. Definition of terms and functions; use of system and applications software; procedures for system initialization, start-up, and shutdown; alarm reports; reports generation, database format and data entry requirements; directory of all disk files; and description of all communications protocols including data formats, command characters, and a sample of each type of data transfer.
4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:
 - a. Computers and peripherals; system start-up and shutdown procedures; use of system, command, and applications software; recovery and restart procedures; graphic alarm presentation; use of report generator and generation of reports; data entry; operator commands' alarm messages, and printing formats; and system access requirements.
5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, recommend schedules, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
6. Spare Parts and Components Data: At the conclusion of the Contractor's work, the Contractor shall submit to the Resident Engineer a complete list of the manufacturer's recommended spare parts and components required to satisfactorily maintain and service the systems, as well as unit pricing for those parts and components.
7. Operation, Maintenance & Service Manuals: The Contractor shall provide two (2) complete sets of operating and maintenance manuals in the form of an instructional manual for use by the VA Security Guard Force personnel. The manuals shall be organized into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder. If multiple volumes are required, each volume shall be fully indexed and coordinated.
8. Equipment and Systems Maintenance Manual: The Contractor shall provide the following descriptive information for each piece of equipment, operating system, and electronic system:
 - a. Equipment and/or system function.
 - b. Operating characteristics.
 - c. Limiting conditions.
 - d. Performance curves.
 - e. Engineering data and test.
 - f. Complete nomenclature and number of replacement parts.

- g. Provide operating and maintenance instructions including assembly drawings and diagrams required for maintenance and a list of items recommended to stock as spare parts.
 - h. Provide information detailing essential maintenance procedures including the following: routine operations, trouble shooting guide, disassembly, repair and re-assembly, alignment, adjusting, and checking.
 - i. Provide information on equipment and system operating procedures, including the following; start-up procedures, routine and normal operating instructions, regulation and control procedures, instructions on stopping, shut-down and emergency instructions, required sequences for electric and electronic systems, and special operating instructions.
 - j. Manufacturer equipment and systems maintenance manuals are permissible.
9. Project Redlines: During construction, the Contractor shall maintain an up-to-date set of construction redlines detailing current location and configuration of the project components. The redline documents shall be marked with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office. The Contractor will provide access to redline documents anytime during the project for review and inspection by the Resident Engineer or authorized Office of Protection Services representative. Master redlines shall be neatly maintained throughout the project and secured under lock and key in the contractor's onsite project office. Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings. Prior to producing Record Construction Documents, the contractor will submit the Master Redline document to the Resident Engineer for review and approval of all changes or modifications to the documents. Each sheet shall have Resident Engineer initials indicating authorization to produce "As Built" documents. Field drawings shall be used for data gathering and field changes. These changes shall be made to the master redline documents daily. Field drawings shall not be considered "master redlines".

10. Record Specifications: The Contractor shall maintain one (1) copy of the Project Specifications, including addenda and modifications issued, for Project Record Documents. The Contractor shall mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in the Contract Specifications and modifications issued. (Note related Project Record Drawing information where applicable). The Contractor shall pay particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Upon completion of the mark ups, the Contractor shall submit record Specifications to the COTR. As with master relines, Contractor shall maintain record specifications for Resident Engineer review and inspection at anytime.
11. Record Product Data: The Contractor shall maintain one (1) copy of each Product Data submittal for Project Record Document purposes. The Data shall be marked to indicate the actual product installed where the installation varies substantially from that indicated in the Product Data submitted. Significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation shall be included. Particular attention will be given to information on concealed products and installations that cannot be readily identified or recorded later. Note related Change Orders and mark up of Record Construction Documents, where applicable. Upon completion of mark up, submit a complete set of Record Product Data to the COTR.
12. Miscellaneous Records: The Contractor shall maintain one (1) copy of miscellaneous records for Project Record Document purposes. Refer to other Specifications for miscellaneous record-keeping requirements and submittals concerning various construction activities. Before substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records include, a minimum of the following:
 - a. Certificates received instead of labels on bulk products.
 - b. Testing and qualification of tradesmen. ("Contractor's Qualifications")
 - c. Documented qualification of installation firms.
 - d. Load and performance testing.
 - e. Inspections and certifications.
 - f. Final inspection and correction procedures.
 - g. Project schedule

13. Record Construction Documents (Record As-Built)

- a. Upon project completion, the contractor shall submit the project master redlines to the Resident Engineer prior to development of Record construction documents. The Resident Engineer shall be given a minimum of a thirty (30) day review period to determine the adequacy of the master redlines. If the master redlines are found suitable by the Resident Engineer, the Resident Engineer will initial and date each sheet and turn redlines over to the contractor for as built development.
- b. The Contractor shall provide the Resident Engineer a complete set of "as-built" drawings and original master redlined marked "as-built" blue-line in the latest version of AutoCAD drawings unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, data gathering panel number, and input or output number as applicable. All corrective notations made by the Contractor shall be legible when submitted to the COTR. If, in the opinion of the COTR, any redlined notation is not legible, it shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted as built shall be in editable formats and the ownership of the drawings shall be fully relinquished to the owner.
- c. Where feasible, the individual or entity that obtained record data, whether the individual or entity is the installer, sub-contractor, or similar entity, is required to prepare the mark up on Record Drawings. Accurately record the information in a comprehensive drawing technique. Record the data when possible after it has been obtained. For concealed installations, record and check the mark up before concealment. At the time of substantial completion, submit the Record Construction Documents to the COTR. The Contractor shall organize into bound and labeled sets for the COTR's continued usage. Provide device, conduit, and cable lengths on the conduit drawings. Exact in-field conduit placement/routings shall be shown. All conduits shall be illustrated in their entire length from termination in security closets; no arrowed conduit runs shall be shown. Pull box and junction box sizes are to be shown if larger than 100mm (4 inch).

O. FIPS 201 Compliance Certificates

1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:
 - a. Card Readers
 - b. Certificate Management
 - 1) CAK Authentication System
 - 2) PIV Authentication System
 - 3) Certificate Validator
 - 4) Cryptographic Module

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

1.6 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. American National Standards Institute (ANSI)/ Security Industry Association (SIA):
- AC.....Access Control: Access Control Guideline Dye Sublimation
Printing Practices for PVC Access Control Cards
- TVAC.....CCTV to Access Control Standard - Message Set for System
Integration
- C. American National Standards Institute (ANSI)/ International Code Council (ICC):
- A117.1.....Standard on Accessible and Usable Buildings and Facilities
- D. Department of Justice American Disability Act (ADA)
- 28 CFR Part 36ADA Standards for Accessible Design 2010
- E. Department of Veterans Affairs (VA):
- PACS-R:Physical Access Control System (PACS) Requirements
- VA Handbook 0730Security and Law Enforcement
- F. Government Accountability Office (GAO):
- GAO-03-8.....Security Responsibilities for Federally Owned and Leased
Facilities
- G. National Electrical Contractors Association
- 303Installing Closed Circuit Television (CCTV) Systems
- H. National Electrical Manufacturers Association (NEMA):
- 25-11Enclosures for Electrical Equipment (1000 Volts Maximum)

- I. National Fire Protection Association (NFPA):
 - 70-11 National Electrical Code
- J. Underwriters Laboratories, Inc. (UL):
 - 294 The Standard of Safety for Access Control System Units
 - 305 Standard for Panic Hardware
 - 639 Standard for Intrusion-Detection Units
 - 752 Standard for Bullet-Resisting Equipment
 - 827 Central Station Alarm Services
 - 1076 Standards for Proprietary Burglar Alarm Units and Systems
 - 1981 Central Station Automation System
 - 2058 High Security Electronic Locks
- K. Homeland Security Presidential Directive (HSPD):
 - HSPD Policy for a Common Identification Standard for Federal
Employees and Contractors
- L. Federal Communications Commission (FCC):
 - (47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems
- M. Federal Information Processing Standards (FIPS):
 - FIPS-201-1 Personal Identity Verification (PIV) of Federal Employees and
Contractors
- N. National Institute of Standards and Technology (NIST):
 - IR 6887 V2.1 Government Smart Card Interoperability Specification (GSC-IS)
 - Special Pub 800-63 Electronic Authentication Guideline
 - Special Pub 800-96 PIV Card Reader Interoperability Guidelines
 - Special Pub 800-73-3 Interfaces for Personal Identity Verification (4 Parts)
 - Pt. 1- End Point PIV Card Application Namespace, Data Model
& Representation
 - Pt. 2- PIV Card Application Card Command Interface
 - Pt. 3- PIV Client Application Programming Interface
 - Pt. 4- The PIV Transitional Interfaces & Data Model
Specification
 - Special Pub 800-78-2 Cryptographic Algorithms and Key Sizes for Personal Identity
Verification
 - Special Pub 800-79-1 Guidelines for the Accreditation of Personal Identity Verification
Card Issuers

- Special Pub 800-85B-1DRAFTPIV Data Model Test Guidelines
- Special Pub 800-85A-2PIV Card Application and Middleware Interface Test Guidelines
(SP 800-73-3 compliance)
- Special Pub 800-96PIV Card Reader Interoperability Guidelines
- Special Pub 800-37Guide for Applying the Risk Management Framework to Federal
Information Systems
- Special Pub 800-96PIV Card Reader Interoperability Guidelines
- Special Pub 800-96PIV Card Reader Interoperability Guidelines
- Special Pub 800-104AScheme for PIV Visual Card Topography
- Special Pub 800-116Recommendation for the Use of PIV Credentials in Physical
Access Control Systems (PACS)
- O. Institute of Electrical and Electronics Engineers (IEEE):
 - C62.41IEEE Recommended Practice on Surge Voltages in Low-Voltage
AC Power Circuits
- P. International Organization for Standardization (ISO):
 - 7810Identification cards – Physical characteristics
 - 7811Physical Characteristics for Magnetic Stripe Cards
 - 7816-1Identification cards - Integrated circuit(s) cards with contacts -
Part 1: Physical characteristics
 - 7816-2Identification cards - Integrated circuit cards - Part 2: Cards with
contacts -Dimensions and location of the contacts
 - 7816-3Identification cards - Integrated circuit cards - Part 3: Cards with
contacts - Electrical interface and transmission protocols
 - 7816-4Identification cards - Integrated circuit cards - Part 11: Personal
verification through biometric methods
 - 7816-10Identification cards - Integrated circuit cards - Part 4:
Organization, security and commands for interchange
 - 14443Identification cards - Contactless integrated circuit cards;
Contactless Proximity Cards Operating at 13.56 MHz in up to 5
inches distance
 - 15693Identification cards -- Contactless integrated circuit cards -
Vicinity cards; Contactless Vicinity Cards Operating at 13.56
MHz in up to 50 inches distance
- Q. Uniform Federal Accessibility Standards (UFAS) 1984

- R. ADA Standards for Accessible Design 2010
- S. Section 508 of the Rehabilitation Act of 1973

1.7 DEFINITIONS

- A. ABA Track: Magnetic stripe that is encoded on track 2, at 75-bpi density in binary-coded decimal format; for example, 5-bit, 16-character set.
- B. Access Control List: A list of (identifier, permissions) pairs associated with a resource or an asset. As an expression of security policy, a person may perform an operation on a resource or asset if and only if the person's identifier is present in the access control list (explicitly or implicitly), and the permissions in the (identifier, permissions) pair include the permission to perform the requested operation.
- C. Access Control: A function or a system that restricts access to authorized persons only.
- D. API Application Programming Interface
- E. Assurance Level (or E-Authentication Assurance Level): A measure of trust or confidence in an authentication mechanism defined in OMB Memorandum M-04-04 and NIST Special Publication (SP) 800-63, in terms of four levels: M-04-04
 - 1. Level 1: LITTLE OR NO confidence
 - 2. Level 2: SOME confidence
 - 3. Level 3: HIGH confidence
 - 4. Level 4: VERY HIGH confidence
- F. Authentication: A process that establishes the origin of information, or determines an entity's identity. In this publication, authentication often means the performance of a PIV authentication mechanism.
- G. Authenticator: A memory, possession, or quality of a person that can serve as proof of identity, when presented to a verifier of the appropriate kind. For example, passwords, cryptographic keys, and fingerprints are authenticators.
- H. Authorization: A process that associates permission to access a resource or asset with a person and the person's identifier(s).
- I. BIO or BIO-A: A FIPS 201 authentication mechanism that is implemented by using a Fingerprint data object sent from the PIV Card to the PACS. Note that the short-hand "BIO (-A)" is used throughout the document to represent both BIO and BIO-A authentication mechanisms.
- J. Biometric: An authenticator produced from measurable qualities of a living person.
- K. CAC EP – CAC End Point with end point PIV applet.
- L. CAC NG – CAC Next Generation with transitional PIV applet.

- M. Card Authentication Key (CAK): A PIV authentication mechanism (or the PIV Card key of the same name) that is implemented by an asymmetric or symmetric key challenge/response protocol. The CAK is an optional mechanism defined in NIST SP 800-73. (SP800-73) NIST strongly recommends that every PIV Card contain an asymmetric CAK and corresponding certificate, and that agencies use the asymmetric CAK protocol, rather than a symmetric CAK protocol, whenever the CAK authentication mechanism is used with PACS.
- N. CCTV: Closed-circuit television.
- O. Central Station: A PC with software designated as the main controlling PC of the PACS. Where this term is presented with initial capital letters, this definition applies.
- P. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- Q. CPU: Central processing unit.
- R. Credential: Data assigned to an entity and used to identify that entity.
- S. File Server: A PC in a network that stores the programs and data files shared by users.
- T. FIPS Federal Information Processing Standards
- U. FRAC – First Responder Authentication Credential
- V. HSPD Homeland Security Presidential Directive
- W. I/O: Input/Output.
- X. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- Y. IEC International Electrotechnical Commission
- Z. ISO International Organization for Standardization
- AA. KB Kilobyte
- BB. kbit/s Kilobits / second
- CC. LAN: Local area network.
- DD. LED: Light-emitting diode.
- EE. Legacy CAC – Contact only Common Access Card with v1 and v2 applets.
- FF. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.
- GG. NIST: National Institute of Standards and Technology

HH. PACS: Physical Access Control System

II. PC/SC: Personal Computer / Smart Card

JJ. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.

KK. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).

LL. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.

MM.PIV: Personal Identification Verification

NN. PIV-I – PIV Interoperable credential

OO. PPS: Protocol and Parameters Selection

PP. RF: Radio frequency.

QQ. ROM: Read-only memory. ROM data are maintained through losses of power.

RR. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.

SS. RS-485: An TIA/EIA standard for multipoint communications.

TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

UU. TPDU: Transport Protocol Data Unit

VV. TWIC – Transportation Worker Identification Credential

WW.UPS: Uninterruptible power supply.

XX. Vcc: Voltage at the Common Collector

YY. WAN: Wide area network.

ZZ. WAV: The digital audio format used in Microsoft Windows.

AAA.Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.

BBB. Windows: Operating system by Microsoft Corporation.

CCC. Workstation: A PC with software that is configured for specific limited security system functions.

1.8 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 3. To allow right of way for piping and conduit installed at required slope.
 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

1.9 MAINTENANCE & SERVICE

A. General Requirements

1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.

B. Description of Work

1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, physical access control equipment, facility interface, signal transmission equipment, and video equipment.

C. Personnel

1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The Resident Engineer shall be advised in writing of the name of the designated service representative, and of any change in personnel. The Resident Engineer shall be provided copies of system manufacturer certification for the designated service representative.

D. Schedule of Work

1. The work shall be performed during regular working hours, Monday through Friday, excluding federal holidays. These inspections shall include:
 - a) The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
 - 1) Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
 - 2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices, monitors, check, walk test, and calibrate each sensor; run all system software diagnostics and correct all problems; and resolve any previous outstanding problems.

E. Emergency Service

1. The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.
 - a. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from arrival on site. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.
 - b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.

F. Operation

1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.

G. Records and Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

H. Work Request

1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

I. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the COTR. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COTR. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.

J. Software

1. The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

1.10 PERFORMANCE REQUIREMENTS

- A. PACS shall provide support for multiple authentication modes and bidirectional communication with the reader. PACS shall provide implementation capability for enterprise security policy and incident response.
- B. All processing of authentication information must occur on the “safe side” of a door
- C. Physical Access Control System shall provide access to following Security Areas:
 - 1. Controlled
 - 2. Limited
 - 3. Exclusion
- D. PACS shall provide:
 - 1. One authentication factor for access to Controlled security areas
 - 2. Two authentication factors for access to Limited security areas
 - 3. Three authentication factors for access to Exclusion security areas
- E. PACS shall provide Credential Validation and Path Validation per NIST 800-116.
- F. The PACS System shall have an Enterprise Path Validation Module (PVM) component that processes X.509 certification paths composed of X.509 v3 certificates and X.509 v2 CRLs. The PVM component MUST support the following features:
 - 1. Name chaining;
 - 2. Signature chaining;
 - 3. Certificate validity;
 - 4. Key usage, basic constraints, and certificate policies certificate extensions;
 - 5. Full CRLs; and
 - 6. CRLs segmented on names.
- G. Distributed Processing: System shall be a fully distributed processing system so that information, including time, date, valid codes, access levels, and similar data, is downloaded to Controllers so that each Controller makes access-control decisions for that Location. Do not use intermediate Controllers for physical access control. If communications to Central Station are lost, all Controllers shall automatically buffer event transactions until communications are restored, at which time buffered events shall be uploaded to the Central Station.
- H. Data Capacity:
 - 1. 130 different card-reader formats.
 - 2. 999 comments.
 - 3. 16 graphic file types for importing maps.

- I. Location Capacity:
 - 1. 128 reader-controlled doors.
 - 2. 50,000 total access credentials.
 - 3. 2048 supervised alarm inputs.
 - 4. 2048 programmable outputs.
 - 5. 32,000 custom action messages per Location to instruct operator on action required when alarm is received.
- J. System Network Requirements:
 - 1. Interconnect system components and provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
 - 2. Communication shall not require operator initiation or response, and shall return to normal after partial or total network interruption such as power loss or transient upset.
 - 3. System shall automatically annunciate communication failures to the operator and identify the communication link that has experienced a partial or total failure.
 - 4. Communications Controller may be used as an interface between the Central Station display systems and the field device network. Communications Controller shall provide functions required to attain the specified network communications performance.
- K. Central Station shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring. Central Station shall control system networks to interconnect all system components, including workstations and field-installed Controllers.
- L. Field equipment shall include Controllers, sensors, and controls. Controllers shall serve as an interface between the Central Station and sensors and controls. Data exchange between the Central Station and the Controllers shall include down-line transmission of commands, software, and databases to Controllers. The up-line data exchange from the Controller to the Central Station shall include status data such as intrusion alarms, status reports, and entry-control records. Controllers are classified as alarm-annunciation or entry-control type.

- M. System Response to Alarms: Field device network shall provide a system end-to-end response time of 1 second or less for every device connected to the system. Alarms shall be annunciated at the Central Station within 1 second of the alarm occurring at a Controller or device controlled by a local Controller, and within 100 ms if the alarm occurs at the Central Station. Alarm and status changes shall be displayed within 100 ms after receipt of data by the Central Station. All graphics shall be displayed, including graphics-generated map displays, on the console monitor within 5 seconds of alarm receipt at the security console. This response time shall be maintained during system heavy load.
- N. False Alarm Reduction: The design of Central Station and Controllers shall contain features to reduce false alarms. Equipment and software shall comply with SIA CP-01.
- O. Error Detection: A cyclic code error detection method shall be used between Controllers and the Central Station, which shall detect single- and double-bit errors, burst errors of eight bits or less, and at least 99 percent of all other multibit and burst error conditions. Interactive or product error detection codes alone will not be acceptable. A message shall be in error if one bit is received incorrectly. System shall retransmit messages with detected errors. A two-digit decimal number shall be operator assignable to each communication link representing the number of retransmission attempts. When the number of consecutive retransmission attempts equals the assigned quantity, the Central Station shall print a communication failure alarm message. System shall monitor the frequency of data transmission failure for display and logging.
- P. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.
- Q. Door Hardware Interface: Coordinate with Division 08 Sections that specify door hardware required to be monitored or controlled by the PACS. The Controllers in this Section shall have electrical characteristics that match the signal and power requirements of door hardware. Integrate door hardware specified in Division 08 Sections to function with the controls and PC-based software and hardware in this Section.
- R. References to industry and trade association standards and codes are minimum installation requirement standards.
- S. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.11 EQUIPMENT AND MATERIALS

- 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 prior to final inspection and not more than 90 days after completion of the tests.
 - 3. 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.

1.12 WARRANTY OF CONSTRUCTION.

- A. Warrant PACS work subject to the Article “Warranty of Construction” of FAR clause 52.246-21.
- B. Demonstration and training shall be performed prior to system acceptance.

1.13 GENERAL REQUIREMENTS

- A. General requirements applicable to this section include:
 - 1. General Arrangement Of Contract Documents,
 - 2. Delivery, Handling and Storage,
 - 3. Project Conditions,
 - 4. Electrical Power,
 - 5. Lightning, Power Surge Suppression, and Grounding,
 - 6. Electronic Components,
 - 7. Substitute Materials and Equipment, and
 - 8. Like Items.

PART 2 – PRODUCTS

2.1 GENERAL

- A. All equipment and materials for the system will be compatible to ensure correct operation as outlined in FIPS 201, March 2006 and HSPD-12.
- B. The security system characteristics listed in this section will serve as a guide in selection of equipment and materials for the PACS. If updated or more suitable versions are available then the Contracting Officer will approve the acceptance of prior to an installation.
- C. PACS equipment shall meet or exceed all requirements listed below.
- D. A PACS shall be comprised of, but not limited to, the following components:
 - 1. Physical Access Control System
 - 2. Application Software
 - 3. System Database
 - 4. Surge and Tamper Protection
 - 5. Standard Workstation Hardware
 - 6. Communications Workstation
 - 7. Controllers (Data Gathering Panel)
 - 8. Secondary Alarm Annunciator
 - 9. Keypads
 - 10. Card Readers
 - 11. Credential Cards
 - 12. System Sensors and Related Equipment
 - 13. Push Button Switches
 - 14. Interfaces
 - 15. Door and Gate Hardware interface
 - 16. RS-232 ASCII Interface
 - 17. Cables
 - 18. Transformers

2.2 SECURITY MANAGEMENT SYSTEM (SMS)

- A. This section specifies the finishing, installation, connection, testing and certification of a complete and fully operating expansion to the existing Hirsch Physical Access Control System, hereinafter referred to as the PACS.
- B. The PACS expansion for this project shall provide, as a minimum, the same hardware, software, programming, operational features and security features as provided in the existing system.

- C. Contractor shall provide all hardware, software, firmware, programming, conductors, power, labor and all other items and appurtenances required for a completely operational and acceptable expansion to the existing Hirsch PACS system.

2.3 APPLICATION SOFTWARE

- A. Contractor shall provide and install all upgrades, patches and programming required to upgrade the existing Hirsch SMS application software to the current revision.
- B. Contractor shall be responsible for any and all licensing fees that may be associated with the expansion of the existing Hirsch SMS application software.

2.4 SURGE AND TAMPER PROTECTION

- A. Refer to Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

2.5 PACS SERVER HARDWARE

- A. This section specifies the finishing, installation, connection, testing and certification of a complete and fully operating expansion to the existing Hirsch Physical Access Control System., hereinafter referred to as the PACS.
- B. The PACS expansion for this project shall provide, as a minimum, the same hardware, software, programming, operational features and security features as provided in the existing system.
- C. Contractor shall provide all hardware, software, firmware, programming, conductors, power, labor and all other items and appurtenances required for a completely operational and acceptable expansion to the existing Hirsch PACS server.

2.6 STANDARD WORKSTATION HARDWARE

- A. There are no workstations being added to the Hirsch PACS system in this project.

2.7 COMMUNICATIONS WORKSTATION

- A. There are no communications workstations being added to the Hirsch PACS system in this project.

2.8 CONTROLLERS

- A. Controllers: Intelligent peripheral control unit, complying with UL 294, that stores time, date, valid codes, access levels, and similar data downloaded from the Central Station or workstation for controlling its operation.
- B. Contractor shall provide and install controllers as manufactured by Hirsch to match existing. Controllers supplied and installed under this contract shall provide, as a minimum, the level of communications, security and other features of the existing Hirsch controllers.
- C. Battery Backup: Sealed, lead acid; sized to provide run time during a power outage of 90 minutes, complying with UL 924.

2.9 PIV MIDDLEWARE

- A. PIV Middleware shall provide three-factor authentication, including biometric matching using a fingerprint capture device capable of single fingerprint capture. Unit shall enable digital certificates can to be verified by security personnel using the issuer's certificate authority, SCVP, OCSP responder/repeater, or the TSA hot list for TWIC cardholders. All cards shall be validated using FIPS-201 challenge-response protocol in order to identify forged or cloned cards. PIV Middleware solution shall validate all PIV, TWIC, NG CAC, and FRAC cards. TWIC card FASC-Ns shall also be verified against a live or cached TSA hot list.
- B. PIV Middleware shall have ability to:
 - 1. Verify cardholder identity and validates FIPS 201-compliant PIV-II, next-generation (NG) CAC, TWIC, or FRAC credentials in real-time
 - 2. Perform three-factor authentication of cardholder using PIN, biometrics, and certificate (or serial numbers) detecting forged or cloned cards
 - 3. Enroll FASC-N, photo, and pertinent cardholder information into PACS software
 - 4. Automatically suspend a cardholder's badge if his or her PIV, TWIC, or CAC card certificate serial number is on the Certificate Revocation List (CRL)
 - 5. Upload a cardholder transaction audit trail to central database or exports it to a .csv file for centralized transaction management
 - 6. Be compatible with biometric mobile terminal for off-site verification and enrollment
 - 7. Re-validate imported cardholder certificates on a periodic basis via the Internet
 - 8. Operate with commercial, off-the-shelf (COTS) FIPS 201 PIV-II and ANSI INCITS 378-compliant fingerprint capture devices
 - 9. Revalidate imported cardholder certificates at regular intervals, ensuring that the credentials used in PACS system are backed by a valid set of digital certificates. Digital certificates are verified against local OCSP repeater/validation authority using the issuer's validation authority, or Microsoft Crypto Application Programming Interface (API) on Windows XP SP3 or Vista.
 - 10. Certificate Manager shall fully support SCVP and OCSP for fast, online validation.
 - 11. Provide verification of TWIC credentials against a live TSA hot list.
 - 12. Support uploading local transactions to a central database for consolidated activity reporting. This application shall support a variety of ODBC- or ADO-compliant databases, including Oracle, SQL Server 2005, Informix, DB2, and Firebird.
 - 13. Provide user with ability to produce canned transaction log queries as well as creating queries directly from the SQL database.

C. PIV Middleware PC requirements:

1. PIV Middleware software shall operate on Intel-based PC with minimum 1.8 GHz CPU, 1 GB RAM, 40 GB hard disk, and Microsoft Windows XP SP2 with Microsoft .NET Framework 2.0
2. Unit shall fingerprint capture devices and smart card reader.

D. PIV Middleware shall be FIPS 201 approved product.

2.10 CARD READERS

- A. Contractor shall provide and install card readers as manufactured by (or compatible with) Hirsch to match existing. Card readers supplied and installed under this contract shall provide, as a minimum, the level of communications, security and other features of the existing card readers.
- B. Each card reader shall be suitable for surface, semi-flush or pedestal mounting.
- C. Each card reader housing shall be suitable for the environment in which it is to be installed.

2.11 BIOMETRIC IDENTITY VERIFICATION EQUIPMENT

- A. There is no biometric identity verification equipment required on this project.

2.12 KEYPADS

- A. There are no PACS keypads required on this project.

2.13 CREDENTIAL CARDS

- A. There are no credential cards being supplied as part of this project.

2.14 SYSTEM SENSORS AND RELATED EQUIPMENT

- A. The PACS (Physical Access Control System) and related Equipment provided by the Contractor shall meet or exceed the following performer specifications.

B. Request to Exit Detectors:

1. Passive Infrared Request to Exit Motion Detector (REX PIR) (1) The Contractor shall provide a surface mounted motion detector to signal the physical access control system request to exit input. The motion detector shall be a passive infrared sensor designed for wall or ceiling mounting 2134 to 4572 mm (7 to 15 ft) height. The detector shall provide two (2) form "C" (SPDT) relays rated one (1) Amp. @ 30 VDC for DC resistive loads. The detectors relays shall be user adjustable with a latch time from 1-60 seconds. The detector shall also include a selectable relay reset mode to follow the timer or absence of motion. The detection pattern shall be adjustable plus or minus fourteen (± 14) degrees. The detector shall operate on 12 VDC with approximately 26 mA continuous current draw. The detector shall have an externally visible activation LED. The motion detector shall measure approximately 38 mm H x 158 mm W x 38 mm D (1.5 x 6.25 x 1.5 in). The detector shall be immune to radio frequency interference. The detector shall not activate or set-up on critical frequencies in the range 26 to 950 Megahertz using a 50 watt transmitter located 30.5 cm (1 ft) from the unit or attached wiring. The detector shall be available on gray or black enclosures. The color of the housing shall be coordinated with the surrounding surface.

C. Guard tour stations:

1. There are no guard tour stations required on this project.

D. Delayed Egress (DE)

1. The delay egress locking hardware will be provided and installed by others. The PACS contractor shall connect the delay egress locking hardware to the PACS and shall coordinate all connections and programming with the General Contractor.

E. Local Exit with Alarm:

1. The local exit alarm door hardware will be provided and installed by others. The PACS contractor shall monitor the alarm output via connection to the PACS and shall coordinate all connections and programming with the General Contractor.

F. Key Bypass:

1. There are no key bypass switches required on this project.

G. Automatic Door Opener and Closer:

1. Automatic door openers and closers will be provided and installed by the door hardware provider.
2. The PACS contractor will be responsible to coordinate with the General Contractor and door hardware provider in order to monitor the status of the automatic doors and to provide controlled access via the PACS system.

H. Door Status Indicators:

1. Shall monitor and report door status to the SMS.
2. Door Position Sensor:
 - a. Shall provide an open or closed indication for all doors operated on the PACS and report directly to the SMS.
 - b. Shall also provide alarm input to the Intrusion Detection System for all doors operated by the PACS and all other doors that require monitoring by the intrusion detection system.
 - c. Switches for doors operated by the PACS shall be double pole double throw (DPDT). One side of the switch shall monitor door position and the other side if the switch shall report to the intrusion detection system where shown on the plans. For doors with electromagnetic locks a magnetic bonding sensor (MBS) can be used in place of one side of a DPDT switch, in turn allowing for the use of a single pole double throw (SPDT) switch in its place of a DPDT switch.
 - d. Switches for doors not operated by the PACS shall be SPDT and report directly to the IDS.
 - e. Shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2" (5 cm).

2.14 PUSH BUTTON SWITCHES

- A. Push-Button Switches: Momentary-contact back-lighted push buttons, with stainless-steel switch enclosures.
1. Electrical Ratings:
 - a. Electrical rating shall be suitable for the application.
 2. Enclosures: Flush or surface mounting. Push buttons shall be suitable for flush mounting in the switch enclosures.
 3. Enclosures shall additionally be suitable for installation in the following locations:
 - a. Indoors, controlled environment.
 - b. Indoors, uncontrolled environment.
 - c. Outdoors.
 4. Power: Push-button switches shall be powered from their associated Controller, using DC control.

2.15 PORTAL CONTROL DEVICES

- A. Shall be used to assist the PACS.
- B. Such devices shall:
 - 1. Provide a means of monitoring the doors status.
 - 2. Allow for exiting a space via either a push button, request to exit, or panic/crash bar.
 - 3. Provide a means of override to the PACS via a keypad or key bypass.
 - 4. Assist door operations utilizing automatic openers and closures.
 - 5. Provide a secondary means of access to a space via a keypad.
- C. Shall be connected to and monitored by the main PACS panel.
- D. Shall be installed in a manner that they comply with:
 - 1. The Uniform Federal Accessibility Standards (UFAS)
 - 2. The Americans with Disabilities Act (ADA)
 - 3. The ADA Standards for Accessible Design
- E. Shall provide a secondary means of physical access control within a secure area.
- F. Push-Button Switches:
 - 1. Shall be momentary contact, back lighted push buttons, and stainless steel switch enclosures for each push button as shown. Buttons are to be utilized for secondary means of releasing a locking mechanism.
 - a. In an area where a push button is being utilized for remote access of the locking device then no more than two (2) buttons shall operate one door from within one secure space. Buttons will not be wired in series with one other.
 - 2. Shall have double-break silver contacts that will make 720 VA at 60 amperes and break 720 VA at 10 amperes.
 - 3. When being utilized for emergency request-to-exit, shall have a 30 second pneumatic delay on relock in order to meet egress code requirements.
- G. Entry Control Devices:
 - 1. Shall be hardwired to the PACS main control panel and operated by either a card reader or a biometric device via a relay on the main control panel.
 - 2. Shall be fail-safe in the event of power failure to the PACS system.
 - 3. Shall operate at 24 VCD, with the exception of turnstiles and be powered by a separate power supply dedicated to the door control system. Each power supply shall be rated to operate a minimum of two doors simultaneously without error to the system or overload the power supply unit.

4. Shall have a diode or metal-oxide varistor (MOV) to protect the controller and power supply from reverse current surges or back-check.
5. Electromagnetic Locks:
 - a. Electromagnetic locks will be provided and installed by the door hardware contractor.

2.16 WIRES AND CABLES

- A. Refer to Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall install all system components and appurtenances in accordance with the manufacturers' instructions, ANSI C2, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.
- B. Consult the manufacturers' installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all schematic system installation/termination/wiring data.
- C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

3.2 CURRENT SITE CONDITIONS

- A. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions which will affect performance of the system to the Owner in a report as defined in paragraph Group II Technical Data Package. The Contractor shall not take any corrective action without written permission from the Owner.

3.3 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

- B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PREPARATION

- A. Comply with recommendations in SIA CP-01.
- B. Comply with EIA/TIA-606, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."
- C. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project plans and specifications and publish as Project planning documents for review and approval.
 - 1. Record setup data for control station and workstations.
 - 2. For each Location, record setup of Controller features and access requirements.
 - 3. Propose start and stop times for time zones and holidays, and match up access levels for doors.
 - 4. Set up groups, linking, and list inputs and outputs for each Controller.
 - 5. Assign action message names and compose messages.
 - 6. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
 - 7. Prepare and install alarm graphic maps.
 - 8. Develop user-defined fields.
 - 9. Develop screen layout formats.
 - 10. Propose setups for guard tours and key control.
 - 11. Discuss badge layout options; design badges.
 - 12. Complete system diagnostics and operation verification.
 - 13. Prepare a specific plan for system testing, startup, and demonstration.
 - 14. Develop acceptance test concept and, on approval, develop specifics of the test.
 - 15. Develop cable and asset management system details; input data from construction documents. Include system schematics and Technical Drawings.
- D. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

3.5 CABLING

- A. Comply with NECA 1, "Good Workmanship in Electrical Contracting."

- B. Install cables and wiring according to requirements in Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY.
- C. Wiring Method: Install wiring in raceway and cable tray, or other acceptable cable management system, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
- D. Install LAN cables using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.
- E. Install cables without damaging conductors, shield, or jacket.
- F. Boxes and enclosures containing security system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered to be accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.
- G. Install end-of-line resistors at the field device location and not at the Controller or panel location.

3.6 CABLE APPLICATION

- A. Comply with EIA/TIA-569, "Commercial Building Standard for Telecommunications Pathways and Spaces."
- B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.
- C. RS-232 Cabling: Install at a maximum distance of 50 feet (15 m).
- D. RS-485 Cabling: Install at a maximum distance of 4000 feet (1220 m).
- E. Card Readers and Keypads:
 - 1. Install number of conductor pairs recommended by manufacturer for the functions specified.
 - 2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from Controller to the reader is 250 feet (75 m), and install No. 20 AWG wire if maximum distance is 500 feet (150 m).
 - 3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the Controller.
 - 4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.

- F. Install minimum No. 16 AWG cable from Controller to electrically powered locks. Do not exceed 250 feet or manufacturer's recommendation (whichever is the lesser).
- G. Install minimum No. 18 AWG ac power wire from transformer to Controller, with a maximum distance of 25 feet or manufacturer's recommendation (whichever is the lesser).

3.7 GROUNDING

- A. Comply with Section 28 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- B. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."
- C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- D. Signal Ground:
 - 1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
 - 2. Bus: Mount on wall of main equipment room with standoff insulators.
 - 3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.8 INSTALLATION

- A. System installation shall be in accordance with UL 294, manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.
- B. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.
- C. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.4 and 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a operable system.
- D. The PACS will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a network.
- E. For programming purposes refer to the manufacturers requirements for correct system operations. Ensure computers being utilized for system integration meet or exceed the minimum system requirements outlined on the systems software packages.

- F. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system. The Contractor shall not take any corrective action without written permission from the Government.
- G. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.
- H. Existing Equipment:
1. The Contractor shall connect to and utilize existing door equipment, control signal transmission lines, and devices as outlined in the design package. Door equipment and signal lines that are usable in their original configuration without modification may be reused with Contracting Officer approval.
 2. The Contractor shall perform a field survey, including testing and inspection of all existing door equipment and signal lines intended to be incorporated into the PACS, and furnish a report to the Contracting Officer as part of the site survey report. For those items considered nonfunctioning, provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include a schedule for connection to all existing equipment.
 3. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Contracting Officer approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or control line, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment.
 4. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or improper installation of equipment.
 5. The Contracting Officer shall be provided a full list of all equipment that is to be removed or replaced by the Contractor, to include description and serial/manufacturer numbers where possible. The Contractor shall dispose of all equipment that has been removed or replaced based upon approval of the Contracting Officer after reviewing the equipment removal list. In all areas where equipment is removed or replaced the Contractor shall repair those areas to match the current existing conditions.

- I. Enclosure Penetrations: All enclosure penetrations shall be from the bottom of the enclosure unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water and will comply with Section 07 84 00, FIRESTOPPING. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer and in such a manner that the cable is not damaged.
- J. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.
- K. Control Panels:
 - 1. Connect power and signal lines to the controller.
 - 2. Program the panel as outlined by the design and per the manufacturer's programming guidelines.
- L. SMS:
 - 1. Coordinate with the VA agency's IT personnel to place the computer on the local LAN or Intranet and provide the security system protection levels required to insure only authorized VA personnel have access to the system.
 - 2. Program and set-up the SMS to ensure it is in fully operation.
- M. Card Readers:
 - 1. Connect all signal inputs and outputs as shown and specified.
 - 2. Terminate input signals as required.
 - 3. Program and address the reader as per the design package.
 - 4. Readers shall be surface or flushed mounted and all appropriate hardware shall be provided to ensure the unit is installed in an enclosed conduit system.
- N. Door Status Indicators:
 - 1. Install all signal input and output cables as well as all power cables.
 - 2. RTE's shall be surface mounted and angled in a manner that they cannot be compromised from the non-secure side of a windowed door, or allow for easy release of the locking device from a distance no greater than 6 feet from the base of the door.
 - 3. Door position sensors shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2" (5 cm).
- O. Entry Control Devices:
 - 1. Install all signal input and power cables.

2. Strikes and bolts shall be mounted within the door frame.
3. Mortise locks shall be mounted within the door and an electric transfer hinge shall be utilized to transfer the wire from within the door frame to the mortise lock inside the door.
4. Electromagnetic locks shall be installed with the mag-lock mounted to the door frame and the metal plate mounted to the door.

P. System Start-Up:

1. The Contractor shall not apply power to the PACS until the following items have been completed:
 - a. PACS equipment items and have been set up in accordance with manufacturer's instructions.
 - b. A visual inspection of the PACS has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
 - c. System wiring has been tested and verified as correctly connected as indicated.
 - d. All system grounding and transient protection systems have been verified as installed and connected as indicated.
 - e. Power supplies to be connected to the PACS have been verified as the correct voltage, phasing, and frequency as indicated.
2. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.
3. The Resident Engineer will observe startup and contractor testing of selected equipment. Provide a minimum of 7 days prior notice.

Q. Supplemental Contractor Quality Control:

1. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed PACS; and are approved by the Contracting Officer.
2. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
3. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
4. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.

3.9 SYSTEM SOFTWARE

- A. Install, configure, and test software and databases for the complete and proper operation of systems involved. Assign software license to Owner.

3.10 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Testing Agency: Engage an approved qualified testing and inspecting agency to perform field tests and inspections and prepare test reports:
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 6 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-568-1, "Commercial Building Telecommunications Cabling Standards - Part 1 General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA-568-B.
 - 2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
 - 3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

3.11 PROTECTION

- A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured, with an activated burglar alarm and access-control system reporting to a Central Station complying with UL 1610, "Central-Station Burglar-Alarm Units," during periods when a qualified operator in the employ of Contractor is not present.

3.12 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.

- B. Submit training plans and instructor qualifications.
- C. Develop separate training modules for the following:
 - 1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
 - 2. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
 - 3. Security personnel.
 - 4. Hardware maintenance personnel.
 - 5. Corporate management.
- D. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

-----END-----

SECTION 28 16 11

INTRUSION DETECTION SYSTEM - EXTENSION

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Provide and install a complete addition to the existing Intrusion Detection System as manufactured by Edwards System Technology (EST), hereinafter referred to as IDS, as specified in this section.
- B. The IDS expansion for this project shall provide, as a minimum, the same hardware, software, programming and operational features, communications features and security features as provided in the existing system.
- C. System Architecture:
 - 1. Contractor shall be responsible to provide all hardware, software, firmware, programming, conductors, power, labor and all other items and appurtenances required for a completely operational and acceptable expansion to the existing EST 3 IDS system.
- D. This Section includes the following:
 - 1. Intrusion detection with hard-wired and multiplexed, modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.
 - 2. Responsibility for integrating electronic and electrical systems and equipment is specified in the following Sections, with Work specified in this Section:
 - a. Section 08 71 00, DOOR HARDWARE
 - b. Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEM - EXTENSION
- E. Related Sections include the following:
 - 1. Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, for cabling between central-station control units and field-mounted devices and controllers.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS: For General Requirements.
- B. Section 07 84 00, FIRESTOPPING: Requirements for firestopping application and use.
- C. Section 10 14 00, SIGNAGE: Requirements for labeling and signs.
- D. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements for connection of high voltage.
- E. Section 26 05 21, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Requirements for power cables.

- F. Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY: Requirements for general requirements that are common to more than one section in Division 28.
- G. Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY: Requirements for conductors and cables.
- H. Section 28 05 26, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY: Requirements for grounding of equipment.
- I. Section 28 05 28.33, CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY: Requirements for infrastructure.

1.3 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project's sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute's Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.4 QUALITY ASSURANCE

- A. The Contractor shall be responsible for providing, installing, and the operation of the IDS as shown. The Contractor shall also provide certification as required.
- B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.

1.5 DEFINITIONS

- A. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- B. I/O: Input/Output.
- C. Intrusion Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.

- D. LED: Light-emitting diode.
- E. NEC: National Electric Code
- F. NEMA: National Electrical Manufacturers Association
- G. NFPA: National Fire Protection Association
- H. NRTL: Nationally Recognized Testing Laboratory.
- I. SMS: Security Management System – A SMS is software that incorporates multiple security subsystems (e.g., physical access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.
- J. PIR: Passive infrared.
- K. RF: Radio frequency.
- L. Standard Intruder: A person who weighs 45 kg (100 lb.) or less and whose height is 1525 mm (60 in) or less; dressed in a long-sleeved shirt, slacks, and shoes.
- M. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.
- N. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- O. UPS: Uninterruptible Power Supply
- P. UTP: Unshielded Twisted Pair

1.6 SUBMITTALS

- A. Submit below items in conjunction with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 02 41 19, SELECTIVE DEMOLITION.
- B. Provide certificates of compliance with Section 1.3, Quality Assurance.
- C. Provide a shop drawing and as-built design package in both electronic format and on paper, minimum size 1220 x 1220 millimeters (48 x 48 inches); drawing submittals shall be per the established project schedule.
- D. Shop drawing and as-built packages shall include, but not be limited to:
 - 1. Index Sheet that shall:
 - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
 - b. Provide a list of all security abbreviations and symbols.
 - c. Reference all general notes that are utilized within the design package.
 - d. Specification and scope of work pages for all security systems that are applicable to the design package that will:
 - 1) Outline all general and job specific work required within the design package.

- 2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
 - a. Include a title block as defined above.
 - b. Define the drawings scale in both standard and metric measurements.
 - c. Provide device identification and location.
 - d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
 - e. Identify all pull box and conduit locations, sizes, and fill capacities.
 - f. Address all general and drawing specific notes for a particular drawing sheet.
3. A riser drawing for each applicable security subsystem shall:
 - a. Indicate the sequence of operation.
 - b. Relationship of integrated components on one diagram.
 - c. Include the number, size, identification, and maximum lengths of interconnecting wires.
 - d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
4. A system drawing for each applicable security system shall:
 - a. Identify how all equipment within the system, from main panel to device, shall be laid out and connected.
 - b. Provide full detail of all system components wiring from point-to-point.
 - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
 - d. Show device locations that correspond to the floor plans.
 - e. All general and drawing specific notes shall be included with the system drawings.
5. A schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
 - a. Device ID.
 - b. Device Location (e.g. site, building, floor, room number, location, and description).
 - c. Mounting type (e.g. flush, wall, surface, etc.).
 - d. Power supply or circuit breaker and power panel number.
 - e. In addition, for the IDS, provide the sensor ID, sensor type and housing model number.

6. Detail and elevation drawings for all devices that define how they were installed and mounted.
- E. Shop drawing packages shall be reviewed by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
 1. 35 percent
 2. 65 percent
 3. 90 percent
 4. 100 percent
- F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
- G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS.

1.7 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. American National Standards Institute (ANSI)/Security Industry Association (SIA):
 - PIR-01Passive Infrared Motion Detector Standard - Features for
Enhancing False Alarm Immunity
 - CP-01Control Panel Standard-Features for False Alarm Reduction
- C. Department of Justice American Disability Act (ADA)
 - 28 CFR Part 36ADA Standards for Accessible Design
- D. Federal Communications Commission (FCC):
 - (47 CFR 15) Part 15Limitations on the Use of Wireless Equipment/Systems
- E. National Electrical Manufacturers Association (NEMA):
 - 250-11Enclosures for Electrical Equipment (1000 Volts Maximum)
- F. National Fire Protection Association (NFPA):
 - 70-11National Electrical Code

731Standards for the Installation of Electric Premises Security
Systems

G. Underwriters Laboratories, Inc. (UL):

464Audible Signal Appliances
609Local Burglar Alarm Units and Systems
634Standards for Connectors with Burglar-Alarm Systems
639Standards for Intrusion Detection Units
1037Standard for Anti-theft Alarms and Devices
1635Digital Alarm Communicator System Units

H. Uniform Federal Accessibility Standards (UFAS).

1.8 COORDINATION

A. Coordinate arrangement, mounting, and support of intrusion detection system equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

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

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

1.9 EQUIPMENT AND MATERIALS

A. General

1. All equipment associated within the IDS shall be rated for continuous operation. Environmental conditions (i.e. temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.
2. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 60 Hz AC power system unless documented otherwise in subsequent sections listed within this specification. All equipment shall have a back-up source of power that will provide a minimum of 96 hours of run time in the event of a loss of primary power to the facility.

3. The system shall be designed, installed, and programmed in a manner that will allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.
4. All IDS components located in designated “HAZARDOUS ENVIRONMENT” areas where fire or explosion could occur due to the presence of natural gases or vapors, flammable liquids, combustible residue, or ignitable fibers or debris, shall be rated Class II, Division I, Group F, and installed in accordance with National Fire Protection Association (NFPA) 70 National Electric Code, Chapter 5.
5. All equipment and materials for the system will be compatible to ensure functional operation in accordance with requirements.

1.10 WARRANTY OF CONSTRUCTION.

- A. Warrant IDS work subject to the Article “Warranty of Construction” of FAR 52.246-21.
- B. Demonstration and training shall be performed prior to system acceptance.

PART 2 – PRODUCTS

2.1 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. This project is an expansion of the existing EST 3 IDS.

2.2 SYSTEM COMPONENT REQUIREMENTS

- A. The IDS expansion of the EST 3 system for this project shall provide, as a minimum, the same hardware, software, programming operational features and security features a provided by the existing EST 3 system.

2.3 ENCLOSURES

- A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.
- B. Interior Electronics: NEMA 250, Type 12.
- C. Exterior Electronics: NEMA 250, Type 4X fiberglass.
- D. Corrosion Resistant: NEMA 250, Type 4X PVC stainless steel.
- E. Screw Covers: Where enclosures are accessible to inmates, secure with security fasteners of type appropriate for enclosure.

2.4 EQUIPMENT ITEMS

A. General:

1. All requirements listed below are the minimum specifications that need to be met in order to comply with the IDS.
2. All IDS sensors shall conform to UL 639, Intrusion Detection Standard.

B. IDS Components: The IDS shall consist of, but not be limited to, the following components:

1. Control Panel
2. Exterior Detection Devices
3. Interior Detection Devices
4. Power Supply
5. Enclosures

2.5 CONTROL PANEL

- A. The Control panel shall be an EST 3 system as manufactured by Edwards Systems Technology and shall be completely compatible with the existing EST 3 IDS network.
- B. The Control panel shall provide, as a minimum, the same hardware, software, programming, operational features and security features as provided in the existing system.

2.6 KEYPADS

- A. Key pads shall match devices currently installed on the existing EST 3 IDS system.

2.7 INPUT MODULE

- A. An input module shall be utilized to connect additional detection devices to the control panel. Input modules shall match devices currently installed on the existing EST 3 IDS system.

2.8 OUTPUT MODULE

- A. An output module shall be utilized to interface the control panel with other security subsystems, as required. Output modules shall match devices currently installed on the existing EST 3 IDS system.

2.9 INTERIOR DETECTION DEVICES (SENSORS)

- A. The IDS shall consist of interior, exterior, and other detection devices that are capable of:
 1. Locating intrusions at individually protected asset areas or at an individual portal;
 2. Locating intrusions within a specific area of coverage;
 3. Locating failures or tampering of individual sensors or components.
- B. Provide and adjust for devices so that coverage is maximized in the space or area it is installed in. For large rooms where multiple devices are required, ensure device coverage is overlapping.

- C. Detection sensitivity shall be set up to ensure maximum coverage of the secure area is obtained while at the same time limiting excessive false alarms due to the environment and impact of small animals. All detection devices shall be anti-masking with exception of video motion detection.
- D. Dual sensor technology shall be used when possible. Sensor technology shall not be of the same type that is easily defeated by a single method. This will reduce the amount of false alarms.
- E. Interior Environmental Conditions: Systems shall be able to operate in environmentally protected interior areas and shall meet operational performance requirements for the following ambient conditions:

- 1. If components are installed in unheated areas they shall be able to operate in temperatures as low as -17 C (0 F);
- 2. Interior Sensor Environmental Characteristics:

Temperatures	0 to 50 C (32F to 120 F)
Pressure	Sea Level to 4573m (15,000 ft.) above sea level
Humidity	5% - 95%
Fungus	Components of non-fungus nutrient materials
Acoustical Noise	Suitable for high noise environments above 100db

F. Passive Infrared Motion Sensors (PIR)

- 1. These sensors shall detect an intruder presence by monitoring the level of infrared energy emitted by objects within a protected zone and meet ANSI PIR-01 Passive Infrared Motion Detector Standards Features for Enhancing False Alarm Immunity. An alarm shall be initiated when motion and temperature changes within set patterns are detected as follows.
- 2. The detector shall provide multiple detection zones distributed at a variety of angles and distance.
- 3. Sensors shall be passive in nature; no transmitted energy shall be required for detection.
- 4. Sensors shall be sensitive to infrared energy emitted at wavelengths corresponding to human body and other objects at ambient temperatures.
- 5. Sensors shall not alarm in response to general area thermal variations and shall be immune to radio frequency interference.
- 6. Sensors shall not be susceptible to changes in temperature due to an air conditioner being turned on or off.
- 7. Sensors shall be housed in a tamper-alarmed enclosure.
- 8. Sensor detectors shall include motion analyzer processing, adjustable lens, and walk test LED's visible from any angle.

9. Sensors shall provide some means of indicating an alarm condition during installation and calibration. A means of disabling the indication shall be provided within the sensor enclosure.
10. Sensor detectors shall include a motion monitoring verification circuit that will signal trouble or alarm if the detector fails to detect motion for an extended period.
11. PIR Technical Characteristics:

Power	Six (6) – 12 VDC 25 mA continuous current draw 38 mA peaks
Alarm Velocity	1500 mm (Five (5) ft.) at a velocity of 30 mm (0.1 ft.) per second, and one (1) step per second, assuming 150 mm (6 in.) per step. Also, faster than 30 mm (1 foot) per second, up to 3000 mm (10 feet) per second
Maximum detection range	10.6 m (35 ft.)
Frequency range- non activation or setup use	26 to 950 MHz using a 50 watt transmitter located 1 ft. from the unit or attached wiring
Infrared detection	1 1/2°C (3°F) different from the background temperature
Detection Pattern	180 degrees for volumetric units, non PIR 360
PIR 360°Detection Pattern	Programmable 60 detection zones including one directly below
Mounting	Ceiling and walls
Ceiling heights	2.4 m (Eight (8) ft.) – 5.4 m (18 ft)
Sensitivity adjustments	Three (3) levels

2.10 TAMPER ALARM SWITCHES

- A. The following IDS sensors shall be used to monitor and detect potential tampering of sensors, control panels and enclosures.
 1. Tamper Switches: All enclosures including cabinets, housings, boxes, raceways, and fittings with hinged doors or removable covers containing circuits and power supplies related to the IDS shall include corrosion-resistant tamper switches.
 2. Tamper alarms shall be annunciated to be clearly distinguishable from IDS alarms.
 3. Tamper switches will not be in a viewable from a direct line of sight perspective. The minimum amount of time the tamper switch becomes active and sends a signal after an enclosure is opened or panel removable is attempted, shall be one (1) second.

4. Tamper switches will initiate when enclosure doors or covers is removed as little as 6.35 mm (1/4 inch) from the closed position unless otherwise indicated. Tamper switches shall be:
 - a. Push/pull automatic reset type;
 - b. Inaccessible until switch is activated;
 - c. Spring-loaded and held in closed position by door or cover; and
 - d. Wired to break a circuit when door or cover is removed with each sensor annunciated individually at a central reporting processor.
5. Fail-Safe Mode: Shall provide the capability to detect and annunciate diminished functional capabilities and perform self-tests. Fail-safe alarms shall be annunciated to be clearly distinguishable from other types of alarms.

2.11 POWER SUPPLY

- A. A power supply shall only be utilized if the control panel is unable to support the load requirements of the IDS system.
- B. All power supplies shall be UL rated and able to adequately power two entry control devices on a continuous base without failure.
- C. Power supplies shall meet the following minimum technical characteristics:

INPUT POWER	110 VAC 60 HZ 2 amp
OUTPUT VOLTAGE	12 VDC Nominal (13.8 VDC) 24 VDC Nominal (27.6 VDC) Filtered and Regulated
BATTERY	Provide sufficient battery to produce 96 hours of standby power
OUTPUT CURRENT	4 amp max. @ 13.8 VDC 3 amp max. @ 27.6 VDC
BATTERY FUSE SIZE	3.5 A @ 250 VAC
CHARGING CIRCUIT	Built-in standard

2.12 AUDIBLE AND VISUAL ALARM DEVICES

- A. Siren: 30-W speaker with siren driver, rated to produce a minimum sound output of 103 dB at 10 feet (3 m) from central-station control unit.
 1. Enclosure: Weather-resistant steel box with tamper switches on cover and on back of box.
- B. Strobe: Xenon light complying with UL 1638, with a clear polycarbonate lens.
 1. Light Output: 115 cd, minimum.
 2. Flash Rate: 60 per minute.

2.13 SECURITY FASTENERS

- A. Security fasteners shall be operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.
- B. Drive System Types: Pinned Torx or pinned hex (Allen).
- C. Socket Flat Countersunk Head Fasteners:
 - 1. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
 - 2. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.
- D. Socket Button Head Fasteners:
 - 1. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
 - 2. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.
- E. Socket Head Cap Fasteners:
 - 1. Heat-treated alloy steel, ASTM A 574 (ASTM A 574M).
 - 2. Stainless steel, ASTM F 837 (ASTM F 837M), Group 1 CW.
- F. Protective Coatings for Heat-Treated Alloy Steel:
 - 1. Zinc chromate, ASTM F 1135, Grade 3 or 4; for exterior applications and interior applications where indicated.
 - 2. Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide.

2.14 BALANCED MAGNETIC SWITCHES (BMS)

- A. BMS switches shall be surface or recessed mounted according to manufacturer's instructions. Recessed mounted is the preferred method to reduce tampering or defeating of the system. Switches shall activate when a disturbance in the balanced magnetic field occurs.
- B. Switches shall have a minimum of two (2) encapsulated reed switches.
- C. Contractor shall provide each BMS with a current protective device, rated to limit current to 80% of the switch capacity.
- D. Surface Mounted BMS: For exterior application, components shall be housed in weatherproof enclosures.
- E. BMS field adjustments in the fixed space between magnet and switch housing shall not be possible. Attempts to adjust or disturb the magnetic field shall cause a tamper alarm.

F. BMS Technical Characteristics:

Maximum current	.25 amperes
Maximum voltage	30 VDC
Maximum power	3.0 W (without internal terminating resistors). 1.0 W (with internal terminating resistors).
Components	Three (3) pre-adjusted reed switches Three (3) pre-adjusted magnets
Output contacts	Transfer type SPDT
Contact rating	0.5 amperes, 28 VDC
Switch mechanism	Internally adjustable ¼ - ½ in. (6-13 mm)
Wiring	Two (2) wires #22 American Wire Gauge (AWG), three (3) or 11 foot attached cable
Activation lifetime	1,000,000 activations
Enclosure	Nonferrous materials
Tamper alarm activation	Cover opened 3 mm (1/8 in.) and inaccessible until actuated

PART 3 - EXECUTION

3.1 INSTALLATION

- A. IDS installation shall be in accordance with Underwriters Laboratories (UL) 639 Standards for Intrusion Detection Units and UL 634 Standards for Connectors with Burglar Alarm Systems, and appropriate manufacture's installation manuals for each type of IDS.
- B. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.
- C. The Contractor shall install all system components including VA furnished equipment, and appurtenances in accordance with the manufacturer's instructions and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.
- D. The IDS will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or designed as a computer network.

- E. For programming purposes, the Contractor shall refer to the manufacturer's requirements and Contracting Officer instructions for correct system operations. This includes ensuring computers being utilized for system integration meet or exceeds the minimum system requirements outlined in the IDS software packages.
- F. Lightning and power surges to the central alarm reporting and display unit shall be protected at both ends against excessive voltages. This requirement shall apply for circuits that are routed both in underground conduits and overhead runs.
- G. At a minimum, the Contractor shall install primary detection devices, such as three electrode gas-type surge arresters, and secondary protectors to reduce dangerous voltages to levels that will cause no damage. Fuses shall not be permitted as protection devices.
- H. The Contractor shall provide fail-safe gas tube type surge arresters on exposed IDS data circuits. In addition, transient protection shall protect against spikes up to 1000 volts peak voltage with a one-microsecond rise time and 100-microsecond decay time, without causing false alarms. The protective device shall be automatic and self-restoring. Also, circuits shall be designed or selected assuming a maximum of 25 ohms to ground.
- I. Product Delivery, Storage and Handling:
 - 1. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name, equipment model and serial identification numbers, and UL logo. The Contracting Officer may inventory the IDS equipment at the time of delivery and reject items that do not conform to this requirement.
 - 2. Storage and Handling: Store and protect equipment in a manner that will preclude damage as directed by the Contracting Officer.
- J. Cleaning and Adjustments:
 - 1. Cleaning: Subsequent to installation, clean each system component of dust, dirt, grease, or oil incurred during installation in accordance to manufacture instructions.
 - 2. Prepare for system activation by following manufacturer's recommended procedures for adjustment, alignment, or synchronization. Prepare each component in accordance with appropriate provisions of the component's installation, operations, and maintenance instructions.
- K. Tamper Switches
 - 1. Install tamper switches to initiate an alarm signal when a panel, box, or component housing door or cover is moved as little as 6.35 mm (1/4 inch) from the normally closed position unless otherwise specified.

2. Locate tamper switches within enclosures, cabinets, housings, boxes, raceways, and fittings to prevent direct line of sight to any internal components and to prevent tampering with switch or circuitry.
3. Conceal tamper switch mounting hardware so that the location of the switch within the enclosure cannot be determined from the exterior.

3.2 WIRING INSTALLATION

- A. Wiring Method: Install wiring in raceways except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (20 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Wiring Method: Cable, concealed in accessible ceilings, walls, and floors when possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Wires and Cables:
 1. Conductors: Size as recommended in writing by system manufacturer, unless otherwise indicated.
 2. 120-V Power Wiring: Install according to Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW), unless otherwise indicated.
 3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable, unless otherwise indicated or if manufacturer recommends shielded cable, according to Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY.
 4. Computer and Data-Processing Cables: Install according to Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- F. Install power supplies and other auxiliary components for detection devices at controllers, unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

- G. Identify components with engraved, laminated-plastic or metal nameplate for central-station control unit and each terminal cabinet, mounted with corrosion-resistant screws.

3.3 GROUNDING

- A. Ground system components and conductor and cable shields 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 rack or cabinet. Isolate from power system and equipment grounding. Provide maximum 5 ohm ground. Measure, record, and report ground resistance.
- C. Install grounding electrodes of type, size, location, and quantity indicated. Comply with installation requirements in Section 28 05 26, GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY SYSTEMS.

3.4 STARTUP AND TESTING

- A. The Resident Engineer will observe startup and contractor testing of selected equipment. Provide a minimum of 7 days prior notice.

3.5 TESTS AND TRAINING

- A. All testing and training shall be compliant with Section 01 00 00, GENERAL REQUIREMENTS.
- B. Provide services of manufacturer's technical representative for 8 hours to instruct VA personnel in operation and maintenance of units.
- C. Submit training plans and instructor qualifications.

-----END-----

SECTION 28 23 00

VIDEO SURVEILLANCE SYSTEM - EXTENSION

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, testing and certification of a complete and fully operational expansion to the existing Speco Technologies Video Surveillance System, which is identified as the Video Assessment and Surveillance System hereinafter referred to as the VASS System as specified in this section.
- B. The VASS expansion for this project shall provide, as a minimum, the same hardware, software, programming, operational features, communications features and security features as provided in the existing VASS.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS: For General Requirements.
- B. Section 07 84 00, FIRESTOPPING: Requirements for firestopping application and use.
- C. Section 10 14 00, SIGNAGE: Requirements for labeling and signs.
- D. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements for connection of high voltage.
- E. Section 26 05 21, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Requirements for power cables.
- F. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Requirements for underground installation of wiring.
- G. Section 26 56 00, EXTERIOR LIGHTING: Requirements for perimeter lighting.
- H. Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY: Requirements for general requirements that are common to more than one section in Division 28.
- I. Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY: Requirements for conductors and cables.
- J. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- K. Section 28 05 28.33, CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY: Requirements for infrastructure.

1.3 DEFINITIONS

- A. AGC: Automatic gain control.
- B. B/W: Black and white.
- C. CCD: Charge-coupled device.
- D. CIF: Common Intermediate Format CIF images are 352 pixels wide and 88/240 (PAL/NTSC) pixels tall (352 x 288/240).
- E. 4CIF: resolution is 704 pixels wide and 576/480 (PAL/NTSC) pixels tall (704 x 576/480).
- F. H.264 (also known as MPEG4 Part 10): a encoding format that compresses video much more effectively than older (MPEG4) standards.
- G. ips: Images per second.
- H. MPEG: Moving picture experts group.
- I. MPEG4: a video encoding and compression standard that uses inter-frame encoding to significantly reduce the size of the video stream being transmitted.
- J. NTSC: National Television System Committee.
- K. UPS: Uninterruptible power supply.
- L. PTZ: refers to a movable camera that has the ability to pan left and right, tilt up and down, and zoom or magnify a scene.

1.4 QUALITY ASSURANCE

- A. The Contractor shall be responsible for providing, installing, and the operation of the VASS System as shown. The Contractor shall also provide certification as required.
- B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.
- D. 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.
- E. 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 three years.
 - 2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

F. Contractor Qualification:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Video Assessment and Surveillance System's (VASS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the VASS. The Contractor shall only utilize factory-trained technicians to install, terminate and service cameras, control, and recording equipment. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The COTR reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.
2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.

- G. 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 (4) hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 SUBMITTALS

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 02 41 19, SELECTIVE DEMOLITION.
- B. Provide certificates of compliance with Section 1.4, Quality Assurance.
- C. Provide a pre-installation and as-built design package in both electronic format and on paper, minimum size 1220 x 1220 millimeters (48 x 48 inches); drawing submittals shall be per the established project schedule.
- D. Pre-installation design and as-built packages shall include, but not be limited to:
1. Index Sheet that shall:
 - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
 - b. Provide a list of all security abbreviations and symbols.
 - c. Reference all general notes that are utilized within the design package.
 - d. Specification and scope of work pages for all security systems that are applicable to the design package that will:
 - 1) Outline all general and job specific work required within the design package.
 - 2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
 2. Floor plans, site plans, and enlarged plans shall:
 - a. Include a title block as defined above.
 - b. Define the drawings scale in both standard and metric measurements.
 - c. Provide device identification and location.
 - d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
 - e. Identify all pull box and conduit locations, sizes, and fill capacities.
 - f. Address all general and drawing specific notes for a particular drawing sheet.
 3. A riser drawing for each applicable security subsystem shall:
 - a. Indicate the sequence of operation.
 - b. Relationship of integrated components on one diagram.
 - c. Include the number, size, identification, and maximum lengths of interconnecting wires.

- d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
 - 4. A system drawing for each applicable security system shall:
 - a. Identify how all equipment within the system, from main panel to device, shall be laid out and connected.
 - b. Provide full detail of all system components wiring from point-to-point.
 - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
 - d. Show device locations that correspond to the floor plans.
 - e. All general and drawing specific notes shall be included with the system drawings.
 - 5. A schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
 - a. Device ID.
 - b. Device Location (e.g. site, building, floor, room number, location, and description).
 - c. Mounting type (e.g. flush, wall, surface, etc.).
 - d. Power supply or circuit breaker and power panel number.
 - e. In addition, for the VASS Systems, provide the camera ID, camera type (e.g. fixed or pan/tilt/zoom (P/T/Z), lens type (e.g. for fixed cameras only) and housing model number.
 - 6. Detail and elevation drawings for all devices that define how they were installed and mounted.
- E. Pre-installation design packages shall be reviewed by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
- 1. 35 percent
 - 2. 65 percent
 - 3. 90 percent
 - 4. 100 percent
- F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.

- G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified.
Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS.

1.6 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. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):
330Electrical Performance Standards for CCTV Cameras
375A.....Electrical Performance Standards for CCTV Monitors
- C. Institute of Electrical and Electronics Engineers (IEEE):
C62.41IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
- D. Federal Communications Commission (FCC):
(47 CFR 15) Part 15Limitations on the Use of Wireless Equipment/Systems
- E. National Electrical Contractors Association (NECA):
303-11Installing Closed Circuit Television (CCTV) Systems
- F. National Fire Protection Association (NFPA):
70-11Article 780-National Electrical Code
- G. Federal Information Processing Standard (FIPS):
140-2Security Requirements for Cryptographic Modules
- H. Underwriters Laboratories, Inc. (UL):
983Standard for Surveillance Camera Units
3044Standard for Surveillance Closed Circuit Television Equipment

1.7 COORDINATION

- A. Coordinate arrangement, mounting, and support of video surveillance equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 3. To allow right of way for piping and conduit installed at required slope.
 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for video surveillance items that are behind finished surfaces or otherwise concealed.

1.8 WARRANTY OF CONSTRUCTION

- A. Warrant VASS System work subject to the Article “Warranty of Construction” of FAR clause 52.246-21.
- B. Demonstration and training shall be performed prior to system acceptance.

1.9 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project’s sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute’s Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Video signal format shall comply with the NTSC standard composite video, interlaced. Composite video signal termination shall be 75 ohms.
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
- C. Power Connections: Comply with requirements in Section 28 05 00, COMMON WORK REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY, as recommended by manufacturer for type of line being protected.
- D. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

2.2 CAMERAS

- A. All Cameras will be EIA 330 and UL 1. Minimum Protection for Power Connections 120 V and more: Auxiliary panel suppressors shall comply with requirements in Section 28 05 00, COMMON WORK REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY.
- B. Minimum Protection for Communication, Signal, Control, and Low-Voltage 983 compliant as well as:
 - 1. Will be charge coupled device (CCD cameras and shall conform to National Television System Committee (NTSC) formatting.
 - 2. Fixed cameras shall be color and the primary choice for monitoring following the activities described below.
 - 3. Shall be powered by either 12 volts direct current (VDC) or 24 volts alternate current (VAC). Power supplies shall be Class 2 and UL compliant and have a back-up power source to ensure cameras are still operational in the event of loss of primary power to the VASS System.
 - 4. Shall be rated for continuous operation under the environmental conditions listed in Part 1, Project Conditions.
 - 5. Will be home run to a monitoring and recording device via a controlling device such as a digital video recorder or network server and monitored on a 24 hour basis at a designated Security Management System location.
 - 6. Each function and activity shall be addressed within the system by a unique user defined name, with minimum of twenty (20) characters. The use of codes or mnemonics identifying the VASS action shall not be accepted.
 - 7. Shall come with built-in video motion detection that shall automatically monitor and process information from each camera. The camera motion detection shall detect motion within the camera's field of view and provide automatic visual, remote alarms as a result of detected motion.
 - 8. Shall be programmed to digitally flip from color to black and white at dusk and vice versa at low light conditions.
 - 9. Will be fitted with AI/DC lenses to ensure the image quality under different light conditions.
 - 10. Dummy or fake cameras will not be utilized at any time.
 - 11. Appropriate signage shall be designed, provided, and posted that notifies people that an area is under camera surveillance.

2.3 VIDEO MANAGEMENT SYSTEM

- A. The Video Management System for this project is an extension and expansion of the existing Speco Technologies VASS.
- B. The VASS expansion for this project shall provide, as a minimum, the same hardware, software, programming, operational features, communications features and security features as provided in the existing system.
- C. The Contractor shall be responsible to provide all hardware, firmware, programming, conductors, power, labor, licenses and all other items and appurtenances required for a completely operational and acceptable expansion to the existing Speco Technologies VASS system.

2.4 VIDEO DISPLAY EQUIPMENT

- A. Video Display Equipment
 - 1. Will consist of color monitors and shall be EIA 375A compliant.
 - 2. Shall be able to display analog, digital, and other images in either NTSC or MPEG format associated with the operation of the Security Management System (SMS).
 - 3. Shall:
 - a. Have front panel controls that provide for power on/off, horizontal and vertical hold, brightness, and contrast.
 - b. Accept multiple inputs, either directly or indirectly.
 - c. Have the capabilities to observe and program the VASS System.
 - d. Be installed in a manner that they cannot be witnessed by the general public.
- B. Provide and install Liquid Crystal Display (LCD) Flat Panel Display Monitors where shown on Contract Drawings.
- C. The 17.1 inch color LCD monitor shall have a flat screen 17.1 inch diagonal viewing area and consists of an LCD panel, bezel, and stand.
- D. The monitor shall meet or exceed the following specifications:
 - 1. The monitor shall incorporate 17.1 inch active matrix TFT LCD panel.
 - a. The pixel pitch of the monitor's LCD panel shall be 0.264 mm horizontal and 0.264 mm vertical.
 - b. The monitor shall have a maximum resolution of 500 television lines.
 - c. The contrast ratio shall be 500:1.
 - d. The typical brightness shall be 250 cd/m²
 - e. The monitor shall display at least 16.7 million colors.
 - f. The light source for the LCD panel shall have a lifetime of 50,000 hours.

- g. The scan frequency horizontal shall be 30 K to 80 KHz and the scan frequency vertical shall be 56 to 75 Hz.
 - h. The viewing angle for the monitor shall be 170 degrees horizontal and 170 degrees vertical.
 - 2. The monitor shall have automatic NTSC or PAL recognition.
 - 3. The monitor shall use the following signal connectors:
 - a. VGA 15-pin D-Sub
 - 4. The monitor shall have the following front control panel buttons:
 - a. Power on/off
 - b. LED indicator
 - c. Mode
 - d. Increase (volume)
 - e. Decrease (volume)
 - f. Up (contrast adjustment)
 - g. Down (brightness adjustment)
 - h. Menu
 - i. Auto
 - 5. The monitor shall have the following options for adjustment in an onscreen display menu:
 - a. Color
 - b. Tint
 - 1) NTSC mode only
 - a) Brightness
 - b) Contrast
 - c) Sharpness
 - d) Volume
 - e) Language
 - f) Scan
 - g) Color Temp
 - h) H-Position
 - i) Recall
- E. The electrical specifications for the monitor shall be as follows:
- 1. Input voltage shall be 120 VAC.
 - 2. Power consumption shall be 300 VA maximum.

F. The environmental specifications for the monitor shall be as follows:

1. Operating temperature shall be 32 to 104 degrees Fahrenheit.
2. Operating humidity shall be 10 to 85 percent.

G. The physical specifications for the monitor shall be as follows:

H. The monitor shall conform to these compliance standards:

1. FCC
2. CE (EMC/LVD)
3. UL

2.5 CONTROLLING EQUIPMENT

A. Provide PCs at each viewing location to operate as controlling equipment.

B. Provide PCs with features in accordance with Speco Technologies requirements in order to run Speco Technologies VASS software.

C. Contractor shall be responsible to supply, install, configure and install Speco Technologies VASS software.

D. Each PC shall be capable of viewing any surveillance camera connected to the VASS.

1. The ability to view any particular surveillance camera shall be pass code protected.

E. Contractor shall be responsible to provide and install CAT 6 cabling between controlling equipment and DVRs as required to provide the capability of viewing any surveillance camera connected to the VASS, as described above.

2.6 VIDEO CAMERAS

A. Fixed Color Camera

1. The camera shall be a high-resolution color video camera with wide dynamic range capturing capability.
2. Comply with UL 639.
3. Pickup Device: 1/3 CCD interline transfer.
4. Signal-to-Noise Ratio: Not less than 50 dB, with the camera AGC off.
5. With AGC, manually selectable on or off.
6. Manually selectable modes for backlight compensation or normal lighting.
7. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
8. White Balance: Auto-tracing white balance, with manually selectable fixed balance option.

9. Fixed Color Cameras Technical Characteristics:

Pickup device	1/3" interline transfer CCD
Total pixels	NTSC: 811(H) x 508(V)
Effective pixels	NTSC: 768(H) x 494(V)
Resolution	500 TV lines
Sync. System	Internal Sync
Scanning system	NTSC: 525 Lines/60 Fields
S/N ratio	More than 48 dB
Electronic shutter	Auto 1/60 (1/50) ~1/100,000 sec.
Min. illumination	0.2 lux F2.0
Video output	Composite 1.0 Vp-p/75 ohm
White balance	Auto
Automatic gain control	ON
Frequency horizontal	NTSC: 15.734 KHz
Frequency vertical	NTSC: 59.94Hz
Lens type	Board lens Automatic Iris / varifocal lens
Focal length	2.6 mm to 6 mm
Power source	DC12V/500mA or AC24/500mA
Power consumption	< 3W

10. Fixed color camera shall be enclosed in vandal resistant dome and have board mounted varifocal lens.
11. Camera accessories shall include, as required:
 - a. Surface mount adapter
 - b. Wall mount adapter
 - c. Flush mount adapter

2.7 POWER SUPPLIES

- A. Power supplies shall be a low-voltage power supplies matched for voltage and current requirements of cameras and accessories, type as recommended by camera manufacturer.
- B. Technical specifications:
 - 1. Input: 115VAC, 50/60Hz, 2.7 amps
 - 2. Outputs:
 - a. Number of individually protected outputs: 16
 - b. PTC protected, power limited
 - c. Output voltage and power:
 - 1) 24VAC @ 12.5 amps (300VA)
 - 3. Illuminated power disconnect circuit breaker with manual reset
 - 4. Surge suppression
 - 5. Camera synchronization
 - 6. Rack mount.
 - 7. Enclosure: NEMA 250 Type 1

2.8 RECORDING DEVICES

- A. Digital video recorders shall be utilized as recording devices.
- B. Contractor shall supply, install and program Speco Technologies D16LS1TB digital video recorders.
- C. Digital video recorders shall be 19 inch rack mountable.
- D. All recording devices shall be 47.5 cm (19 inch) rack-mountable.
- E. All DVRs shall be routed through an encryptor.
- F. Encryptors shall:
 - 1. Comply with FIPS PUB 140-2.
 - 2. Support TCP/IP.
 - 3. Directly interfaces to low-cost commercial routers.
 - 4. Provide packet-based crypto synchronization.
 - 5. Encrypt source and destination IP addresses.
 - 6. Support web browser based management requiring no additional software.
 - 7. Have a high data sustained throughput — 1.544 Mbps (T1) full duplex data rate.
 - 8. Provide for both bridging and routing network architecture support.
 - 9. Support Electronic Key Management System (EKMS) compatible.
 - 10. Have remote management ability.
 - 11. Automatically reconfigure when secure network or wide area network changes.

2.9 RACKMOUNT LCD MONITOR AND KEYBOARD

- A. Provide EIA compliant 19" rackmount LCD monitor, keyboard with integrated touchpad at each DVR rack that incorporates:
 - 1. Rail mounting
 - 2. Minimum 18 gauge steel construction
 - 3. LCD display size shall be 20" diagonal
- B. LCD resolution shall be 1280 x 1024
- C. LCD screen shall have a typical contrast ration of 350:1
- D. Power source shall be 60 Hz, 120 VAC
- E. Keyboard shall have an operating range of 32 F to 122 F
- F. Keyboard and LCD shall comply with part 15 of the FCC rules and comply with CE regulation EN 55 022: Class B
- G. System shall be UL listed

2.10 WIRES AND CABLES

- A. Shall meet or exceed the manufactures recommendation for power and signal.
- B. All conduit, pull boxes, and junction boxes shall be clearly marked with colored permanent tape or paint that will allow it to be distinguished from all other conduit and infrastructure.
- C. High voltage and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High voltage for the security system shall be defined as any cable or sets of cables carrying 30 VDC/VAC or higher.
- D. All cables and conductors, except fiber optic cables, that act as a control, communication, or signal lines shall include surge protection. Surge protection shall be furnished at the equipment end and additional triple electrode gas surge protectors rated for the application on each wire line circuit shall be installed within 1 m. (3 ft.) of the building cable entrance. The inputs and outputs shall be tested in both normal and common mode using the following wave forms:
 - 1. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 watts and peak current of 60 amperes.
 - 2. An 8 microsecond rise time by 20 microsecond pulse width wave form with a peak voltage of 1000 volts and peak current of 500 amperes.
- E. The surge suppression device shall not attenuate or reduce the video or sync signal under normal conditions. Fuses and relays shall not be used as a means of surge protection.

F. Coaxial Cables

1. All video signal cables for the VASS System shall be a coaxial cable and have a characteristic impedance of 75 ohms plus or minus 3 ohms.
2. For runs up to 750 feet use of an RG-59/U is required. The RG-59/U shall be shielded which provides a minimum of 95 percent coverage, with a stranded copper center conductor of a minimum 23 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.
3. For runs between 750 feet and 1250 feet, RG-6/U is required. RG-6/U shall be shielded which provides a minimum of 95 percent coverage, with a stranded copper center conductor of a minimum 18 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.
4. For runs of 1250 to 2750 feet, RG-11/U is required. RG-11/U shall be shielded which provides a minimum of 95 percent coverage, with a stranded copper center conductor of a minimum 14 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.
5. All runs greater than 2750 feet will be substituted with a fiber optic cable. If using fiber optics as a signal carrier then the following equipment will be utilized:
 - a. Multimode fiber optic cable a minimum size of 62 microns
 - b. Video transmitter, installed at the camera that utilizes 12 VDC or 24 VAC for power.
 - c. Video receiver, installed at the switcher.

6. RG-59/U Technical Characteristics

AWG	22
Stranding	7x29
Conductor Diameter	.031 in.
Conductor Material	BCC
Insulation Material	Gas-injected FHDPE
Insulation Diameter	.145 in.
Outer Shield Type	Braid/Braid
Outer Jacket Material	PVC
Overall Nominal Diameter	.242 in.
UL Temperature Rating	75°C
Nom. Characteristic Impedance	75 Ohms
Nom. Inductance	0.094 μ H/ft
Nom. Capacitance	Conductor to Shield 17.0 pF/ft
Nom. Velocity of Propagation	80 %
Nom. Delay	1.3 ns/ft
Nom. Conductor DC Resistance @ 20°C	12.2 Ohms/1000 ft
Nom. Outer Shield DC Resistance @ 20°C	2.4 Ohms/1000 ft
Max. Operating Voltage	UL 300 V RMS

7. RG-6/U Technical Characteristics:

AWG	18
Stranding	7x27
Conductor Diameter	.040 in.
Conductor Material	BC
Insulation Material	Gas-injected FHDPE
Insulation Diameter	.180 in.
Outer Shield Material	Trade Name Duofoil
Outer Shield Type	Tape/Braid
Outer Shield %Coverage	100 %
Outer Jacket Material	PVC
Overall Nominal Diameter	.274 in.
Nom. Characteristic Impedance	75 Ohms
Nom. Inductance	0.106 μ H/ft
Nom. Capacitance	Conductor to Shield 16.2 pF/ft
Nom. Velocity of Propagation	82 %
Nom. Delay	1.24 ns/ft
Nom. Conductor DC Resistance	6.4 Ohms/1000 ft
Nominal Outer Shield DC Resistance @ 20°C	2.8 Ohms/1000 ft
Max. Operating Voltage	UL 300 V RMS

8. RG-11/U Technical Characteristics:

AWG	15
Stranding	19x27
Conductor Diameter	.064 in.
Conductor Material	BC
Insulation Material	Gas-injected FHDPE
Insulation Diameter	.312 in.
Inner Shield Type	Braid
Inner Shield Material	BC - Bare Copper
Inner Shield % Coverage	95 %
Inner Jacket Material	PE – Polyethylene
Inner Jacket Diameter	.391 in.
Outer Shield Type	Braid
Outer Shield Material	BC - Bare Copper
Outer Shield % Coverage	95 %
Outer Jacket Material	Trade Name Belflex
Outer Jacket Material	PVC Blend
Overall Nominal Diameter	.520 in.
Operating Temperature Range	-35°C To +75°C
Non-UL Temperature Rating	75°C
Nom. Characteristic Impedance	75 Ohms
Nom. Inductance	0.097 μ H/ft
Nom. Capacitance	Conductor to Shield 17.3 pF/ft
Nom. Velocity of Propagation	78 %
Nom. Delay	1.30 ns/ft
Nom. Conductor DC Resistance	3.1 Ohms/1000 ft
Nom. Inner Shield DC Resistance	1.8 Ohms/1000 ft
Nom. Outer Shield DC Resistance	1.4 Ohms/1000 ft
Max. Operating Voltage Non-UL	300 V RMS

9. Signal Cables:

- a. Signal wiring for cameras depends on the distance the camera is being installed from either a hub or the server.
- b. If the camera is up to 300 ft from a hub or the server, then use a shielded UTP category 6 cable with standard RJ-45 connector at each end.
- c. If the camera is over 300 ft from a hub or server then utilize a multimode fiber optic cable with a minimum size of 62 microns.
- d. Signal cable requirement in this section also apply to signal cables between DVR and PCs.
- e. Provide a separate cable for power.
- f. CAT 6 Technical Characteristics (or based on manufacturer recommendations):

Number of Pairs	4
Total Number of Conductors	8
AWG	24
Stranding	Solid
Conductor Material	BC - Bare Copper
Insulation Material	PO – Polyolefin
Overall Nominal Diameter	.250 in.
IEC Specification	11801 Category 6
TIA/EIA Specification	568-B.2 Category 6
Max. Capacitance Unbalance	(pF/100 m) 150 pF/100 m
Nom. Velocity of Propagation	70 %
Max. Delay	(ns/100 m) 538 @ 100MHz
Max. Delay Skew	(ns/100m) 45 ns/100 m
Max. Conductor DC Resistance	9.38 Ohms/100
Max. DCR Unbalance@ 20°C	3 %
Max. Operating Voltage	UL 300 V RMS

10. Fiber Optic Cables Technical Characteristics:

Fiber Type	62.5 Micron
Number of Fibers	4
Core Diameter 6	2.5 +/- 2.5 microns
Core Non-Circularity	5% Maximum
Clad Diameter	125 +/- 2 microns
Clad Non-Circularity	1% Maximum
Core-clad Offset	1.5 Microns Maximum
Primary Coating Material	Acrylate
Primary Coating Diameter	245 +/- 10 microns
Secondary Coating Material	Engineering Thermoplastic
Secondary Coating Diameter	900 +/- 50 microns
Strength Member Material	Aramid Yarn
Outer Jacket Material	PVC
Outer Jacket Color	Orange
Overall Diameter	.200 in.
Numerical Aperture	.275
Maximum Gigabit Ethernet	300 meters
Maximum Gigabit Ethernet	550 meters

11. Power Cables

- a. Will be sized accordingly and shall comply with the NEC. High voltage power cables will be a minimum of three conductors, 14 AWG, stranded, and coated with a non-conductive polyvinylchloride (PVC) jacket. Low voltage cables will be a minimum of 18 AWG, stranded and non-conductive polyvinylchloride (PVC) jacket.
- b. Will be utilized for all components of the VASS System that require either a 110 VAC 60 Hz or 220 VAC 50 Hz input. Each feed will be connected to a dedicated circuit breaker at a power panel that is primarily for the security system.
- c. All equipment connected to AC power shall be protected from surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used as a means of surge protection.

- d. Shall be rated for either 110 or 220 VAC, 50 or 60 Hz, and shall comply with VA Master Spec 26 05 21 Low Voltage Electrical Power Conductors and Cables (600 Volts and Below).
- e. Low Voltage Power Cables
 - 1) Shall be a minimum of 18 AWG, Stranded and have a polyvinylchloride outer jacket.
 - 2) Cable size shall determined using a basic voltage over distance calculation and shall comply with the NEC's requirements for low voltage cables.

PART 3 - EXECUTION

3.1. GENERAL

- A. Installation: The Contractor shall install all system components including Owner furnished equipment, and appurtenances in accordance with the manufacturer's instructions, ANSI C2 and as shown, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable data transmission system.
- B. Identification and Labeling: The Contractor shall supply permanent identification labels for each cable at each end that will appear on the as-built drawings. The labeling format shall be identified and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified by type or signal being carried and termination points. The labels shall be printed on letter size label sheets that are self laminated vinyl that can be printed from a computer data base or spread sheet. The labels shall be E-Z code WES12112 or equivalent.
 - 1. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing.
- C. Transient Voltage Surge Suppressors (TVSS): The Contractor shall mount TVSS within 3 m (118 in) of equipment to be protected inside terminal cabinets or suitable NEMA 1 enclosures. Terminate off-premise conductors on input side of device. Connect the output side of the device to the equipment to be protected. Connect ground lug to a low impedance earth ground (less than 10 ohms) via Number 12 AWG insulated, stranded copper conductor.
- D. Contractor's Field Test: The Contractor shall verify the complete operation of the data transmission system during the Contractor's Field Testing. Field test shall include a bit error rate test. The Contractor shall perform the test by sending a minimum of 1,000,000 bits of data on each DTM circuit and measuring the bit error rate. The bit error rate shall not be greater than one (1) bit out of each 100,000 bits sent for each dial-up DTM circuit, and one (1) bit out of 1,000,000 bits sent for each leased or private DTM circuit. The Contractor shall submit a report containing results of the field test.

- E. Acceptance Test and Endurance Test: The wire line data transmission system shall be tested as a part of the completed IDS and EECS during the Acceptance test and Endurance Test as specified.
- F. Identification and Labeling: The Contractor shall supply identification tags or labels for each cable. Cable shall be labeled at both end points and at intermediate hand holes, manholes, and junction boxes. The labeling format shall be identified and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified with type of signal being carried and termination points.

3.2 INSTALLATION

- A. System installation shall be in accordance with NECA 303, manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.
- B. Components shall be configured with appropriate “service points” to pinpoint system trouble in less than 30 minutes.
- C. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.
- D. The VASS System expansion will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a complete network.
- E. A complete VASS System shall be comprised of, but not limited to, the following components:
 - 1. Cameras
 - 2. Lenses
 - 3. Video Display Equipment
 - 4. Camera Housings and Mounts
 - 5. Controlling Equipment
 - 6. Recording Devices
 - 7. Wiring and Cables
- F. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.

G. Existing Equipment

1. The Contractor shall connect to and utilize existing video equipment, video and control signal transmission lines, and devices as outlined in the design package. Video equipment and signal lines that are usable in their original configuration without modification may be reused with Contracting Officer approval.
2. The Contractor shall perform a field survey, including testing and inspection of all existing video equipment and signal lines intended to be incorporated into the VASS System, and furnish a report to the Contracting Officer as part of the site survey report. For those items considered nonfunctioning, provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include a schedule for connection to all existing equipment.
3. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Contracting Officer approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or control line, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment.
4. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or incorrect installation of equipment.
5. The Contracting Officer shall be provided a full list of all equipment that is to be removed or replaced by the Contractor, to include description and serial/manufacture numbers where possible. The Contractor shall dispose of all equipment that has been removed or replaced based upon approval of the Contracting Officer after reviewing the equipment removal list. In all areas where equipment is removed or replaced the Contractor shall repair those areas to match the current existing conditions.

H. Enclosure Penetrations: All enclosure penetrations shall be from the bottom of the enclosure unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water and will comply with VA Master Specification 07 84 00, Firestopping. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer and in such a manner that the cable is not damaged.

- I. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.
- J. Interconnection of Console Video Equipment: The Contractor shall connect signal paths between video equipment as specified by the OEM. Cables shall be as short as practicable for each signal path without causing strain at the connectors. Rack mounted equipment on slide mounts shall have cables of sufficient length to allow full extension of the slide rails from the rack.
- K. Cameras:
 - 1. Install the cameras with the focal length lens as indicated for each zone. Make final field-of-view adjusts in present of Resident Engineer.
 - 2. Connect power and signal lines to the camera.
 - 3. Aim camera to give field of view as needed to cover the alarm zone.
 - 4. Focus the lens to give a sharp picture (to include checking for day and night focus and image quality) over the entire field of view
 - 5. Synchronize all cameras so the picture does not roll on the monitor when cameras are selected.
- L. Monitors:
 - 1. Install the monitors as shown and specified in design and construction documents.
 - 2. Connect all signal inputs and outputs as shown and specified.
 - 3. Terminate video input signals as required.
 - 4. Connect the monitor to AC power.
- M. Controlling Equipment:
 - 1. Install the controlling equipment per design and construction documents, and as specified by the OEM.
 - 2. Connect controlling equipment to AC power (UPS).
 - 3. Connect to VASS network.
 - 4. Install operating system and Video Management Software.
 - 5. Provide Video Management Software programming per VA guidance and the requirements provided by the Owner. Programming shall include:
 - a. Camera names
 - b. Screen views
 - c. Camera recording schedules (continuous and event) driven recording. Events include alarms from other systems (sensors), manual input, and video motion detection.
 - d. Video detection zones for each camera requiring video motion detection

- e. Alarm interface
- f. Alarm outputs
- g. GUI maps, views, icons and actions
- h. Reports

N. Video Recording Equipment:

1. Install the video recording equipment as shown in the design and construction documents, and as specified by the OEM.
2. Connect to IP address supplied by Resident Engineer or designated IT representative.
3. Connect video signal inputs and outputs as shown and specified.
4. Connect alarm signal inputs and outputs as shown and specified.
5. Connect video recording equipment to AC power.
6. Program the video recording equipment;
 - a. Recording schedules
 - b. Camera caption

O. Video Signal Equipment:

1. Install the video signal equipment as shown in the design and construction documents, and as specified by the OEM.
2. Connect video or signal inputs and outputs as shown and specified.
3. Terminate video inputs as required.
4. Connect alarm signal inputs and outputs as required.
5. Connect control signal inputs and outputs as required
6. Connect electrically powered equipment to AC power.

3.3 SYSTEM START-UP

- A. The Contractor shall not apply power to the VASS System until the following items have been completed:
1. VASS System equipment items and have been set up in accordance with manufacturer's instructions.
 2. A visual inspection of the VASS System has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
 3. System wiring has been tested and verified as correctly connected as indicated.
 4. All system grounding and transient protection systems have been verified as installed and connected as indicated.
 5. Power supplies to be connected to the VASS System have been verified as the correct voltage, phasing, and frequency as indicated.

- B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.

3.4 SUPPLEMENTAL CONTRACTOR QUALITY CONTROL

- A. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed VASS System; and are approved by the Contracting Officer.
- B. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
- C. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
- D. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.

3.5 DEMONSTRATION AND TRAINING

- A. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.
- B. Provide services of manufacturer's technical representative for 8 hours to instruct VA personnel in operation and maintenance of units.
- C. Submit training plans and instructor qualifications.

-----END-----

SECTION 28 31 00
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section of the specifications includes the furnishing, installation, and connection of the fire alarm equipment to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, graphics, CAD files, programming, and wiring as shown on the drawings and specified.
- B. Building 171 and 172 shall each contain a new EST-3 voice evacuation panel contained in a CAB 23 enclosure. System shall be tied into the existing "Fire Works" graphical networked system through fiber optics network as indicated.
- C. Fire alarm systems shall comply with requirements of NFPA 72 unless variations to NFPA 72 are specifically identified within these contract documents by the following notation: "variation". The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified NICET level III or a registered fire protection engineer. The NICET certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required by the Contracting Officer or his authorized representative. Installers shall have a minimum of two years experience installing fire alarm systems.
- D. Fire alarm signals:
 - 1. The Towbin Building expansions shall have a voice evacuation fire alarm with a pre-alert signal in accordance with ASA S3.41 to notify all occupants in the respective building to evacuate.
- E. Alarm signals, supervisory signals and system trouble signals shall be distinctly transmitted to the main fire alarm system network and displayed on remote annunciators.
- F. The main fire alarm control unit shall automatically transmit alarm signals to the campus Fire Works network system.

1.2 SCOPE

- A. Building 171 and 172 are new wings to an existing building and network.
- B. A new fire alarm system shall be designed and installed in accordance with the specifications and drawings. Device location and wiring runs shown on the drawings are for reference only unless

specifically dimensioned. Actual locations shall be in accordance with NFPA 72 and this specification.

- C. This building may be provided with access controlled doors, and delayed egress doors. Contractor shall coordinate and provide interface to ensure compliance with criteria on plans and NFPA 101. Fire alarm power panels shall be used to power magnetic hold-open devices. Magnetic hold-open devices shall be wall mounted.
- D. Basic Performance:
 - 1. Alarm and trouble signals from building fire alarm control panel shall be digitally encoded by UL listed electronic devices onto a multiplexed communication system.
 - 2. Response time between alarm initiation (contact closure) and recording at the main fire alarm control unit (appearance on alphanumeric read out) shall not exceed five (5) seconds.
 - 3. The signaling line circuits (SLC) shall be wired Class "B" in accordance with NFPA 72. Isolation shall be provided so that no more than one building can be lost due to a short circuit fault.
 - 4. Initiating device circuits (IDC) shall be wired Style C in accordance with NFPA 72.
 - 5. Signaling line circuits (SLC) within buildings shall be wired Style 4 in accordance with NFPA 72. System shall be provided with minimum of two (2) SLC's.
 - 6. Notification appliance circuits (NAC) shall be wired Class "B" in accordance with NFPA 72.

1.3 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS: Restoration of existing surfaces.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES: Procedures for submittals.
- C. Section 07 84 00, FIRESTOPPING: Fire proofing wall penetrations.
- D. Section 08 71 00, DOOR HARDWARE: Combination Closer-Holders.
- E. Section 09 91 00, PAINTING: Painting for equipment and existing surfaces.
- F. Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS: Sprinkler systems.
- G. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements for items which are common to other Division 26 sections.
- H. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and boxes for cables/wiring.
- I. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW: Cables/wiring.

1.4 SUBMITTALS

- A. General: Submit 4 copies and 1 reproducible in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Drawings:
 - 1. Prepare drawings using AutoCAD 2010+, or Revit software and include all contractors' information. Layering shall be by VA criteria as provided by the Contracting Officer's Technical Representative (COTR). Bid drawing files on AutoCAD will be provided to the Contractor at the pre-construction meeting. The contractor shall be responsible for verifying all critical dimensions shown on the drawings provided by VA.
 - 2. Floor plans: Provide locations of all devices (with device number at each addressable device corresponding to control unit programming), appliances, panels, equipment, junction/terminal cabinets/boxes, risers, electrical power connections, individual circuits and raceway routing, system zoning; number, size, and type of raceways and conductors in each raceway; conduit fill calculations with cross section area percent fill for each type and size of conductor and raceway. Only those devices connected and incorporated into the final system shall be on these floor plans. Do not show any removed devices on the floor plans. Show all interfaces for all fire safety functions. Bid documents show circuit numbers used for voltage drop calculations and bid riser concepts. Contractor is not required to use these same numbers. Contractor shall circuit any devices indicated and not yet circuited.
 - 3. Riser diagrams: Provide, for the entire system, the number, size and type of riser raceways and conductors in each riser raceway and number of each type device per floor and zone. Show door holder interface, elevator control interface, HVAC shutdown interface, fire extinguishing system interface, and all other fire safety interfaces. Show wiring Schedules on the riser diagram for all circuits. Bid drawings show conception relay / control / monitor modules as anticipated. Contractor shall verify exact count, type, and location necessary to achieve project criteria.
 - 4. Detailed wiring diagrams: Provide for control panels, modules, power supplies, electrical power connections, auxiliary relays and annunciators showing termination identifications, size and type conductors, circuit boards, LED lamps, indicators, adjustable controls, switches, ribbon connectors, wiring harnesses, terminal strips and connectors, spare zones/circuits. Diagrams shall be drawn to a scale sufficient to show spatial relationships between components, enclosures and equipment configuration.

5. Two weeks prior to final inspection, the Contractor shall deliver to the COTR one (1) set of reproducible, as-built drawings, two blueline copies and one (1) set of the as-built drawing computer files. As-built drawings (floor plans) shall show all new conduit paths used for the fire alarm system.

C. Manuals:

1. Submit simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets for all items used in the system, power requirements, device wiring diagrams, dimensions, and information for ordering replacement parts.
 - a. Wiring diagrams shall have their terminals identified to facilitate installation, operation, expansion and maintenance.
 - b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.
 - c. Include complete listing of all software used and installation and operation instructions including the input/output matrix chart.
 - d. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate, inspect, test and maintain the equipment and system. Provide all manufacturer's installation limitations including but not limited to circuit length limitations.
 - e. Not used.
 - f. Provide standby battery calculations under normal operating and alarm modes. Batteries shall not be used for magnetic hold-open devices.
 - g. Include information indicating who will provide emergency service and perform post contract maintenance.
 - h. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
 - i. A computerized preventive maintenance schedule for all equipment. The schedule shall be provided on disk in a computer format acceptable to the VAMC and shall describe the protocol for preventive maintenance of all equipment. The schedule shall include the required times for systematic examination, adjustment and cleaning of all equipment. A print out of the schedule shall also be provided in the manual. Provide the disk in a pocket within the manual.
 - j. Furnish manuals in 3 ring loose-leaf binder or manufacturer's standard binder.

- k. A print out for all devices proposed on each signaling line circuit with spare capacity indicated.
- 2. Two weeks prior to final inspection, deliver four copies of the final updated maintenance and operating manual to the COTR.
 - a. The manual shall be updated to include any information necessitated by the maintenance and operating manual approval.
 - b. Complete "As installed" wiring and schematic diagrams shall be included that shows all items of equipment and their interconnecting wiring. Show all final terminal identifications.
 - c. Complete listing of all programming information, including all control events per device including an updated input/output matrix.
 - d. Certificate of Installation as required by NFPA 72 for each building. The certificate shall identify any variations from the National Fire Alarm Code.
 - e. Certificate from equipment manufacturer assuring compliance with all manufacturers installation requirements and satisfactory system operation.

D. Certifications:

- 1. Together with the shop drawing submittal, submit the technician's NICET level III fire alarm certification as well as certification from the control unit manufacturer that the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract maintenance. Also include the name and title of the manufacturer's representative who makes the certification.
- 2. Together with the shop drawing submittal, submit a certification from either the control unit manufacturer or the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.
- 3. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

1.4 SUSTAINABILITY CONSIDERATIONS:

- A. This project is designed and constructed with practices and procedures to meet the project's sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute's Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and

applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

1. Section 01 81 13 SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.6 WARRANTY

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of five (5) years from the date of acceptance of the entire installation by the Contracting Officer.

1.7 GUARANTY PERIOD SERVICES

- A. Complete inspection, testing, maintenance and repair service for the fire alarm system shall be provided by a factory trained authorized representative of the manufacturer of the major equipment for a period of five years from the date of acceptance of the entire installation by the Contracting Officer.
- B. Contractor shall provide all necessary test equipment, parts and labor to perform required inspection, testing, maintenance and repair.
- C. All inspection, testing, maintenance and permanent records required by NFPA 72, and recommended by the equipment manufacturer shall be provided by the contractor. Work shall include operation of sprinkler system alarm and supervisory devices as well as all reused existing equipment connected to the fire alarm system. It shall include all interfaced equipment including but not limited to elevators, HVAC shutdown, access control, and extinguishing systems.
- D. Maintenance and testing shall be performed in accordance with NFPA 72. A computerized preventive maintenance schedule shall be provided and shall describe the protocol for preventive maintenance of equipment. The schedule shall include a systematic examination, adjustment and cleaning of all equipment.
- E. Non-included Work: Repair service shall not include the performance of any work due to improper use, accidents, or negligence for which the contractor is not responsible.
- F. Service and emergency personnel shall report to the Engineering Office or their authorized representative upon arrival at the hospital and again upon the completion of the required work. A copy of the work ticket containing a complete description of the work performed and parts replaced shall be provided to the VA Contracting Officer or his authorized representative.
- G. Emergency Service:
 1. Warranty Period Service: Service other than the preventative maintenance, inspection, and testing required by NFPA 72 shall be considered emergency call-back service and covered

- under the warranty of the installation during the first year of the warranty period, unless the required service is a result of abuse or misuse by the Government. Written notification shall not be required for emergency warranty period service and the contractor shall respond as outlined in the following sections on Normal and Overtime Emergency Call-Back Service. Warranty period service can be required during normal or overtime emergency call-back service time periods at the discretion of the Contracting Officer or his authorized representative.
2. Normal and overtime emergency call-back service shall consist of an on-site response within two hours of notification of a system trouble.
 3. Normal emergency call-back service times are between the hours of 7:30 a.m. and 4:00 p.m., Monday through Friday, exclusive of federal holidays. Service performed during all other times shall be considered to be overtime emergency call-back service. The cost of all normal emergency call-back service for years 2 through 5 shall be included in the cost of this contract.
 4. Overtime emergency call-back service shall be provided for the system when requested by the Government. The cost of the first 40 man-hours per year of overtime call-back service during years 2 through 5 of this contract shall be provided under this contract. Payment for overtime emergency call-back service in excess of the 40 man hours per year requirement will be handled through separate purchase orders. The method of calculating overtime emergency call-back hours is based on actual time spent on site and does not include travel time.
- H. The contractor shall maintain a log at each fire alarm control unit. The log shall list the date and time of all examinations and trouble calls, condition of the system, and name of the technician. Each trouble call shall be fully described, including the nature of the trouble, necessary correction performed, and parts replaced.
- I. In the event that VA modifies the fire alarm system post-Acceptance but during the five year Guaranty Period Service period, Contractor shall be required to verify that the system, as newly modified or added, is consistent with the manufacturer's requirements; any verification performed will be equitably adjusted under the Changes clause. The post-Acceptance modification or addition to the fire alarm system shall not void the continuing requirements under this contract set forth in the Guarantee Period Service provision for the fire alarm system as modified or added. The contract will be equitably adjusted under the Changes clause for such additional performance.

1.8 APPLICABLE PUBLICATIONS

- A. The publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by the basic designation only.
- B. National Fire Protection Association (NFPA):
 - 70-2011National Electrical Code (NEC).
 - 72-2010National Fire Alarm Code.
 - 90A-2009Installation of Air Conditioning and Ventilating Systems.
 - 101-2009Life Safety Code
- C. Underwriters Laboratories, Inc. (UL):
 - 2000-2000.....Fire Protection Equipment Directory
- D. Factory Mutual Research Corp (FM): Approval Guide, 2005 Edition
- E. American National Standards Institute (ANSI):
 - S3.41-1996.....Audible Emergency Evacuation Signal
- F. International Code Council, International Building Code (IBC) 2003 Edition

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS, GENERAL

- A. All equipment and components shall be new and the manufacturer's current model. All equipment shall be tested and listed by Underwriters Laboratories, Inc. or Factory Mutual Research Corporation for use as part of a fire alarm system. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturer's requirements and that satisfactory total system operation has been achieved.

2.2 CONDUIT, BOXES, AND WIRE

- A. Conduit is required. Conduit shall be in accordance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS and as follows:
 - 1. New fire alarm conduit shall be red dipped, by the manufacturer.
 - 2. All new and reused conduit shall be installed in accordance with NFPA 70.
 - 3. Conduit fill shall not exceed 40 percent of interior cross sectional area.
 - 4. All new conduit shall be 19 mm (3/4 inch) minimum.
 - 5. Compression fittings shall be used for conduit.
- B. Wire:
 - 1. Protect existing wiring where buildings will be joined and where network circuits are to be connected.

2. Wiring shall be in accordance with NEC article 760, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW), and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for initiating device circuits and 14 AWG for notification device circuits.
 3. Addressable circuits and wiring used for the multiplex communication loop shall be twisted and shielded unless specifically exempted by the fire alarm equipment manufacturer in writing.
 4. Any fire alarm system wiring that extends outside of a building shall have additional power surge protection to protect equipment from physical damage and false signals due to lightning, voltage and current induced transients. Protection devices shall be shown on the submittal drawings and shall be UL listed or in accordance with written manufacturer's requirements.
 5. All wire or cable used in underground conduits including those in concrete shall be listed for wet locations.
- C. Fiber Optic Cable: Fiber optic cable and modems shall be used to interconnect new fire alarm panels with campus network. System shall incorporate multi-mode 62.5 components. See electrical drawings for coordination of fiber connections.
- D. Terminal Boxes, Junction Boxes, and Cabinets:
1. Shall be galvanized steel in accordance with UL requirements.
 2. All new and reused boxes shall be sized and installed in accordance with NFPA 70.
 3. New and existing covers shall be repainted red in accordance with Section 09 91 00, PAINTING and shall be identified with white markings as "FA" for junction boxes and as "FIRE ALARM SYSTEM" for cabinets and terminal boxes. Lettering shall be a minimum of 19 mm (3/4 inch) high.
 4. Terminal boxes and cabinets shall have a volume 50 percent greater than required by the NFPA 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
 5. Terminal boxes and cabinets shall have identified pressure type terminal strips and shall be located at the base of each riser. Terminal strips shall be labeled as specified or as approved by the COTR.
 6. Terminal gutters shall be used above panels where multiple panels are adjacent to each other.

2.3 FIRE ALARM CONTROL UNIT

A. General:

1. Each building shall be provided with an EST-3 fire alarm control unit and shall operate as a supervised zoned fire alarm system, where shown.
2. Fire alarm system shall utilize voice notification. ASU voice components shall be incorporated within the FACP enclosure.
3. Each power source shall be supervised from the other source for loss of power.
4. All circuits shall be monitored for integrity.
5. Visually and audibly annunciate any trouble condition including, but not limited to main power failure, grounds and system wiring derangement.
6. Transmit digital alarm information to the main fire alarm control unit.

B. Enclosure:

1. The control unit shall be housed in a cabinet suitable for both recessed and surface mounting. Cabinet shall be a CAB-21 Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. Cabinet shall contain all necessary relays, terminals, lamps, and legend plates to provide control for the system.

C. Power Supply:

1. The control unit shall derive its normal power from a 120 volt, 60 Hz dedicated supply connected to the emergency power system. Standby power shall be provided by a 24 volt DC battery as hereinafter specified. The normal power shall be transformed, rectified, coordinated, and interfaced with the standby battery and charger.
2. Power supply for smoke detectors shall be taken from the fire alarm control unit.
3. Provide protectors to protect the fire alarm equipment from damage due to lightning or voltage and current transients.
4. Provide new separate and direct ground lines to the outside to protect the equipment from unwanted grounds.

D. Circuit Supervision: Each alarm initiating device circuit, signaling line circuit, and notification appliance circuit, shall be supervised against the occurrence of a break or ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control unit until manually silenced by an off switch.

E. Supervisory Devices: All sprinkler system valves, post indicator valves (PIV), and main gate valves shall be supervised for off-normal position. Closing a valve shall sound a supervisory signal at the control unit until silenced by an off switch. The specific location of all closed valves

shall be identified at the control unit. Valve operation shall not cause an alarm signal. Low air pressure switches and duct detectors shall be monitored as supervisory signals.

F. Trouble signals:

1. Arrange the trouble signals for automatic reset (non-latching).
2. System trouble switch off and on lamps shall be visible through the control unit door.

G. Function Switches: Provide the following switches in addition to any other switches required for the system:

1. Remote Alarm Transmission By-pass Switch: Shall prevent transmission of all signals to the main fire alarm control unit when in the "off" position. A system trouble signal shall be energized when switch is in the off position.
2. Alarm Off Switch: Shall disconnect power to alarm notification circuits on the local building alarm system. A system trouble signal shall be activated when switch is in the off position.
3. Trouble Silence Switch: Shall silence the trouble signal whenever the trouble silence switch is operated. This switch shall not reset the trouble signal.
4. Reset Switch: Shall reset the system after an alarm, provided the initiating device has been reset. The system shall lock in alarm until reset.
5. Lamp Test Switch: A test switch or other approved convenient means shall be provided to test the indicator lamps.
6. Drill Switch: Shall activate all notification devices without tripping the remote alarm transmitter. This switch is required only for general evacuation systems specified herein.
7. Door Holder By-Pass Switch: Shall prevent doors from releasing during fire alarm tests. A system trouble alarm shall be energized when switch is in the abnormal position.
8. HVAC/Smoke Damper By-Pass: Provide a means to disable HVAC fans from shutting down and/or smoke dampers from closing upon operation of an initiating device designed to interconnect with these devices.

H. Remote Transmissions:

1. Provide capability and equipment for transmission of alarm, supervisory and trouble signals to a listed Central Station monitoring location.
2. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

I. Remote Control Capability: Each building fire alarm control unit shall be installed and programmed so that each must be reset locally after an alarm, before the main fire alarm control unit can be reset. After the local building fire alarm control unit has been reset, then the all system

acknowledge, reset, silence or disabling functions can be operated by the main fire alarm control unit

- J. System Expansion: Design the control units and enclosures so that the system can be expanded in the future (to include the addition of twenty percent more alarm initiating, alarm notification and door holder circuits) without disruption or replacement of the existing control unit and secondary power supply.

2.4 STANDBY POWER SUPPLY

A. Batteries:

1. Batteries shall be of the sealed, maintenance free type, 12-volt nominal each. Two batteries shall be provided for each system to obtain a 24 volt system.
2. Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus fifteen minutes of alarm to an end voltage of 1.14 volts per cell, upon a normal AC power failure.
3. Battery racks shall be steel with an alkali-resistant finish.

B. Battery Charger:

1. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120-volt, 60 hertz emergency power source.
2. Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.
3. Shall have protection to prevent discharge through the charger.
4. Shall have protection for overloads and short circuits on both AC and DC sides.
5. A trouble condition shall actuate the fire alarm trouble signal.
6. Charger shall have automatic AC line voltage regulation, automatic current-limiting features, and adjustable voltage controls.

2.5 ANNUNCIATION

A. Annunciator, Alphanumeric Type (System):

1. Shall be a supervised, LCD display containing a minimum of two lines of 40 characters for alarm annunciation in clear English text.
2. Message shall identify building number, floor, zone, etc on the first line and device description and status (pull station, smoke detector, waterflow alarm or trouble condition) on the second line.
3. The initial alarm received shall be indicated as such.
4. A selector switch shall be provided for viewing subsequent alarm messages.
5. The display shall be UL listed for fire alarm application.
6. Annunciators shall display information for all buildings connected to the system. Local building annunciators, for general evacuation system buildings, shall be permitted when shown on the drawings and approved by the COTR.

2.6 VOICE COMMUNICATION SYSTEM (VCS)

- A. Fire alarm notification shall be through voice evacuation.
- B. Speakers shall be initially tapped at wattage indicated on drawings. Contractor shall allow for adjusting wattage taps during final testing to achieve appropriate audibility levels.
- C. Voice messages shall be professionally recorded and of professional quality for intelligibility.

2.7 ALARM NOTIFICATION APPLIANCES

A. Strobes:

1. Notification models shall be based on Genesis 2 series, and have red trim. Most devices will be wall mounted as depicted on drawings.
2. Xenon flash tube type having selectable candela as indicated on drawings, with a flash rate of 1 HZ. Strobes shall be synchronized by power panel.
3. Backplate shall be red with 13 mm (1/2 inch) permanent white letters. Lettering to read "Fire", be oriented on the wall or ceiling properly, and be visible from all viewing directions.
4. Each strobe circuit shall be calculated using Lump sum calculations and shall provide spare capacity to add additional devices.
5. Strobes may be combined with the audible notification appliances specified herein.

D. Fire Alarm Speakers:

1. Shall be electric, utilizing solid state electronic technology operating on a nominal 25 Volt and/or 70 Volt.
2. Shall be a minimum nominal rating of 80 dBA at ten feet.
3. Mount on removable adapter plates on conduit boxes.

4. Speakers located outdoors or areas subject to water spray shall be of weatherproof type with metal housing and protective grille.
5. Each speaker circuit shall have a minimum of twenty (20) percent spare capacity.

2.8 ALARM INITIATING DEVICES

A. Manual Fire Alarm Stations:

1. Shall be keyed non-breakglass, address reporting type.
2. Station front shall be constructed of a durable material such as cast or extruded metal or high impact plastic. Stations shall be semi-flush type.
3. Where indicated on drawings by "key" Pull stations shall be designed for institutional use and shall require the use of a key by staff to operate. Stations in police area shall be of single action pull down type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled "FIRE".
4. Operating handles shall be constructed of a durable material. On operation, the lever shall lock in alarm position and remain so until reset. A key shall be required to gain front access for resetting, or conducting tests and drills.
5. Unless otherwise specified, all exposed parts shall be red in color and have a smooth, hard, durable finish.
6. Stations identified as key operated only shall have a single standardized lock and key separate from the control equipment.

B. Smoke Detectors:

1. Smoke detectors shall be UL listed for use with the fire alarm control unit being furnished.
2. Smoke detectors shall be addressable type complying with applicable UL Standards for system type detectors. Smoke detectors shall be installed in accordance with the manufacturer's recommendations and NFPA 72.
3. Detectors shall have an indication lamp to denote an alarm condition. Provide remote indicator lamps and identification plates where detectors are concealed from view. Locate the remote indicator lamps and identification plates flush mounted on walls so they can be observed from a normal standing position.
4. All spot type and duct type detectors installed shall be of the photoelectric type.
5. Photoelectric detectors shall be factory calibrated and readily field adjustable. The sensitivity of any photoelectric detector shall be factory set at 3.0 plus or minus 0.25 percent obscuration per foot.
6. Detectors shall provide a visual trouble indication if they drift out of sensitivity range or fail internal diagnostics. Detectors shall also provide visual indication of sensitivity level upon

testing. Detectors, along with the fire alarm control units shall be UL listed for testing the sensitivity of the detectors.

C. Heat Detectors:

1. Not used.

D. Water Flow and Pressure Switches:

1. Wet pipe water flow switches and dry pipe alarm pressure switches for sprinkler systems shall be connected to the fire alarm system by way of an address reporting interface device.
2. All new water flow switches shall be of a single manufacturer and series and non-accumulative retard type. See Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS for new switches added. Connect all switches shown on the approved shop drawings.
3. All new switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds. Timing shall be recorded and documented during testing.

E. Extinguishing System Connections:

1. Kitchen Range Hood and Duct Suppression Systems:
 - a. Each suppression system shall be equipped with a micro-switch connected to the building fire alarm control unit. Discharge of a suppression system shall automatically send a alarm signal to the building fire detection and alarm system for annunciation.
 - b. Operation of this suppression system shall also automatically shut off all sources of fuel and heat to all equipment requiring protection under the same hood.

2.9 SUPERVISORY DEVICES

A. Duct Smoke Detectors:

1. Duct smoke detectors shall be provided and connected by way of an address reporting interface device. Detectors shall be provided with an approved duct housing mounted exterior to the duct, and shall have perforated sampling tubes extending across the full width of the duct (wall to wall). Detector placement shall be such that there is uniform airflow in the cross section of the duct.
2. Interlocking with fans shall be provided in accordance with NFPA 90A and as specified hereinafter under Part 3.2, "TYPICAL OPERATION".
3. Provide remote indicator lamps, key test stations and identification nameplates (e.g. "DUCT SMOKE DETECTOR AHU-X") for all duct detectors. Locate key test stations in plain view on walls or ceilings so that they can be observed and operated from a normal standing position.
4. Coordinate installation and controls with mechanical drawings and electrical drawings.

B. Sprinkler and Standpipe System Supervisory Switches:

1. Each sprinkler system water supply control valve, riser valve or zone control valve, and each standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.
2. PIV (post indicator valve) or main gate valve shall be equipped with a supervisory switch.
3. Valve supervisory switches shall be connected to the fire alarm system by way of address reporting interface device. See Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS for new switches to be added. Connect tamper switches for all control valves shown on the approved shop drawings.
4. The mechanism shall be contained in a weatherproof die-cast aluminum housing that shall provide a 19 mm (3/4 inch) tapped conduit entrance and incorporate the necessary facilities for attachment to the valves.
5. The entire installed assembly shall be tamper-proof and arranged to cause a switch operation if the housing cover is removed or if the unit is removed from its mounting.
6. Where dry-pipe sprinkler systems are installed, high and low air pressure switches shall be provided and monitored by way of an address reporting interface devices.

2.10 ADDRESS REPORTING INTERFACE DEVICE

- A. Shall have unique addresses that reports directly to the building fire alarm panel.
- B. Shall be configurable to monitor normally open or normally closed devices for both alarm and trouble conditions.
- C. Shall have terminal designations clearly differentiating between the circuit to which they are reporting from and the device that they are monitoring.
- D. Shall be UL listed for fire alarm use and compatibility with the panel to which they are connected.
- E. Shall be mounted in weatherproof housings if mounted exterior to a building.

2.11 SMOKE BARRIER DOOR CONTROL

- A. Electromagnetic Door Holders:
 - 1. New Door Holders shall be standard wall mounted electromagnetic type. In locations where doors do not come in contact with the wall when in the full open position, an extension post shall be added to the door bracket.
 - 2. Operation shall be by 24 volt DC supplied from a panel located at the fire alarm control unit. Door holders shall be coordinated as to voltage, ampere drain, and voltage drop, wiring and fire alarm system for operation as specified.
- B. Calculations shall be provided to identify available holders per circuit. Door holders shall be wired to allow releasing doors by smoke zone. Locally installed relays shall be used to release doors upon alarm on either side of doors.
- C. Door holder control circuits shall be electrically supervised.
- D. Smoke detectors shall not be incorporated as an integral part of door holders.

2.12 UTILITY LOCKS AND KEYS:

- A. All key operated test switches, control units, annunciator panels and lockable cabinets shall be provided with a single standardized utility lock and key.
- B. Key-operated manual fire alarm stations shall have a single standardized lock and key separate from the control equipment.
- C. All keys shall be delivered to the COTR.

2.13 SPARE AND REPLACEMENT PARTS

- A. Provide spare and replacement parts as follows:
 - 1. Manual pull stations - 0
 - 2. Key operated manual pull stations - NA
 - 3. Heat detectors - NA
 - 4. Fire alarm strobes - 3
 - 5. Fire alarm bells - 0
 - 6. Fire alarm speakers - 3
 - 7. Smoke detectors - 2
 - 8. Duct smoke detectors with all appurtenances - 1
 - 9. Sprinkler system water flow switch - 0
 - 10. Sprinkler system water pressure switch - 0
 - 11. Sprinkler valve tamper switch - 0
 - 12. Control equipment utility locksets - 1
 - 13. Control equipment keys - 20

14. Key operated manual pull station keys – NA
 15. 2.5 oz containers aerosol smoke – 1 case
 16. Printer paper - NA
 17. Printer replacement ribbons - NA
 18. Monitor modules - 1
 19. Control modules - 1
 20. Fire alarm SLC cable (same as installed) – NA
- B. Spare parts are not the same as and are in addition to extra devices called out on fire alarm drawings.
- C. Spare and replacement parts shall be in original packaging and submitted to the COTR.
- D. Furnish and install a storage cabinet of sufficient size and suitable for storing spare equipment and extra devices not used in construction. Doors shall include a pad locking device. Padlock to be provided by the VA. Location of cabinet to be determined by the COTR.
- E. Provide to the VA, all hardware, software, programming tools, license and documentation necessary to permanently modify the fire alarm system on site. The minimum level of modification includes addition and deletion of devices, circuits, zones and changes to system description, system operation, and digitized evacuation and instructional messages.

2.14 INSTRUCTION CHART:

Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame with a backplate. Install the frame in a conspicuous location observable from each control unit where operations are performed. The card shall show those steps to be taken by an operator when a signal is received under all conditions, normal, alarm, supervisory, and trouble. Provide an additional copy with the binder for the input output matrix for the sequence of operation. The instructions shall be approved by the COTR before being posted.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with NFPA 70, 72, 90A, and 101 as shown on the drawings, and as recommended by the major equipment manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed in accordance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS , Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW), and all penetrations of smoke and fire barriers shall be protected as required by Section 07 84 00, FIRESTOPPING.

- B. All new conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. All existing accessible fire alarm conduit not reused shall be removed.
- C. All new or reused exposed conduit shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas.
- D. Existing devices that are reused shall be properly mounted and installed. Where devices are installed on existing shallow backboxes, extension rings of the same material, color and texture of the new fire alarm devices shall be used. Mounting surfaces shall be cut and patched in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Restoration, and be re-painted in accordance with Section 09 91 00, PAINTING as necessary to match existing.
- E. All fire detection and alarm system devices, control units and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas. Exact locations to be approved by the COTR.
- F. Elevator related devices shall be installed in accordance with notes on fire alarm and electrical drawings.
- G. Wall mounted strobes shall be flush wall mounted 90 to 96 inches above the floor or 150 mm (6 inches) below ceiling, whichever is lower. Locate and mount to maintain a minimum 900 mm (36 inches) clearance from side obstructions. Ceiling mounted devices shall be in approximate location shown on drawings, center of tile, and spaced per indicated candela.
- H. Manual pull stations shall be installed not less than 1050 mm (42 inches) or more than 1200 mm (48 inches) from finished floor to bottom of device and within 1500 mm (60 inches) of an exit door.
- I. Where possible, locate water flow and pressure switches a minimum of 300 mm (12 inches) from a fitting that changes the direction of the flow and a minimum of 900 mm (36 inches) from a valve.
- J. Mount valve tamper switches so as not to interfere with the normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.
- K. Connect flow and tamper switches installed under Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS.//

3.2 TYPICAL OPERATION

- A. Activation of any manual pull station, water flow or pressure switch, kitchen hood suppression system, or smoke detector shall cause the following operations to occur:
 - 1. Reserved.

2. Continuously sound a temporal pattern general alarm and flash all strobes in the building in alarm until reset at the local fire alarm control.
 3. Release any magnetic door holders throughout the building after the alert signal.
 4. Transmit a separate alarm signal, via the main fire alarm control unit to the Central Station.
 5. Unlock the electrically locked exit doors within the zone of alarm.
- B. Operation of a smoke detector at a corridor door used for automatic closing shall also release all the magnetic doors. Operation of a smoke detector at a shutter used for automatic closing shall also release only the shutters for that detector.
- F. Operation of duct smoke detectors shall cause a system supervisory condition and shut down the ventilation system and close the associated smoke dampers as appropriate.
- G. Operation of any sprinkler system valve supervisory switch shall cause a system supervisory condition.

3.3 TESTS

- A. Provide the service of a NICET level III, competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the COTR.
- B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the COTR. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm systems meets all contract requirements. After the system has passed the initial test and been approved by the COTR, the contractor may request a final inspection.
1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
 2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
 3. Run water through all flow switches. Check time delay on water flow switches. Submit a report listing all water flow switch operations and their retard time in seconds.
 4. Open each alarm initiating and notification circuit to see if trouble signal actuates.
 5. Ground each alarm initiation and notification circuit and verify response of trouble signals.

3.4 FINAL INSPECTION AND ACCEPTANCE

- A. Prior to final acceptance a minimum 30 day "burn-in" period shall be provided. The purpose shall be to allow equipment to stabilize and potential installation and software problems and equipment

malfunctions to be identified and corrected. During this diagnostic period, all system operations and malfunctions shall be recorded. Final acceptance will be made upon successful completion of the "burn-in" period and where the last 14 days is without a system or equipment malfunction.

- B. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests in Article 3.3 TESTS and those required by NFPA 72. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a VA representative.

3.5 INSTRUCTION

- A. The manufacturer's authorized representative shall provide instruction and training to the VA as follows:
 - 1. Six one-hour sessions to engineering staff, security police and central attendant personnel for simple operation of the system. Two sessions at the start of installation, two sessions at the completion of installation and two sessions 3 months after the completion of installation.
 - 2. Four two-hour sessions to engineering staff for detailed operation of the system. Two sessions at the completion of installation and two sessions 3 months after the completion of installation.
 - 3. Three eight-hour sessions to electrical technicians for maintaining, programming, modifying, and repairing the system at the completion of installation and one eight-hour refresher session 3 months after the completion of installation.
- B. The Contractor and/or the Systems Manufacturer's representative shall provide a typewritten "Sequence of Operation" including a trouble shooting guide of the entire system for submittal to the VA. The sequence of operation will be shown for each input in the system in a matrix format and provided in a loose leaf binder. When reading the sequence of operation, the reader will be able to quickly and easily determine what output will occur upon activation of any input in the system. The INPUT/OUTPUT matrix format shall be as shown in Appendix A to NFPA 72.
- C. Furnish the services of a competent instructor for instructing personnel in the programming requirements necessary for system expansion. Such programming shall include addition or deletion of devices, zones, indicating circuits and printer/display text.

3.6 SCHEDULES

- A. SMOKE ZONE DESCRIPTIONS: N/A
- B. DIGITIZED VOICE MESSAGES: N/A
- C. LOCATION OF VOICE MESSAGES: N/A

--- END ---

SECTION 28 36 00
AREA OF RESCUE COMMUNICATION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section Includes: Furnish, install, and wire all equipment associated with the installation of an Audio-Visual Rescue Assistance Signal System to comply with ADA requirements. This work shall include a main annunciator panel, remote call stations, power supply, conduit, back boxes, cables and wiring as shown on the drawings and as specified herein.

1.2 RELATED WORK

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- C. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.
- D. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- E. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- F. Section 28 05 00 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.
- G. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- H. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- I. Section 28 05 28.33 - CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.

1.3 SUSTAINABILITY CONSIDERATIONS: This project is designed and constructed with practices and procedures to meet the project's sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute's Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.

- A. Section 01 81 13 SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.4 SUBMITTALS

- A. General: Data sheets on all equipment being provided as well recommended cable types. Internal control cabinet drawings showing internal block diagram connections shall be provided. Wiring diagrams showing typical field wiring connections as well as single line floor plan indicating equipment locations as well as cable routings and quantities.
- B. Product Data: Submit product data, including manufacturer's (Spec-Data) product sheet, for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage and accessories. Include cabling diagrams, wiring diagrams, station installation details, and equipment cabinet details.
- D. Quality Assurance Submittals: Submit the following:
1. Test Reports: Certified test reports showing compliance with specified performance characteristics.
 2. Manufacturer's Instructions: Manufacturer's installation instructions.
 3. Manufacturer's Field Reports: Manufacturer's field reports specified herein.
- E. Closeout Submittals: Submit the following:
1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance. Include troubleshooting guide, wiring terminal identification and equipment parts list.
 2. Warranty: Warranty documents specified herein.

F. Project Closeout

1. A one-year maintenance contract offering continued factory authorized service of this system shall be provided as part of this contract. Built drawings that include changes to wiring, wiring designations, junction box labeling and other pertinent information shall be supplied upon completion of the project.
2. The contractor shall furnish manufacturer's manuals of the completed system including individual specifications sheets, schematics, inter-panel and intra-panel wiring diagrams.
 - a. All information necessary for the proper maintenance and operation of the system must be included.
 - b. Provide four copies.
3. As built drawings that include changes to wiring, wiring designations, junction box labeling, and other pertinent information shall be supplied upon completion of the project.
4. Provide a minimum of two (2) hours of in-service training with the system.
 - a. These sessions shall be broken into segments that will facilitate the training of the system users in operating station equipment.
 - b. Operating manuals and user's guides shall be provided at the time of training.

G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified.

Provide all maintenance and operating manuals per the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

1.5 WARRANTY

- A. The Contractor warrants to the Owner and Engineer that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. The warranty period shall be one year from the dated of the written acceptance of the Work as stated in the Substantial Completion form and executed by the Engineer, Contractor and Owner.

1.6 INSTALLATION STANDARDS

- A. The system shall be installed in accordance with the requirements of the most recent editions of the NEC and ADA.
- B. The completed system shall be in compliance with state and local electrical codes.
- C. All wiring not installed in conduit shall be plenum rated, NEC approved and UL listed for the application.
- D. All wiring shall test free from grounds and shorts.

1.7 SYSTEM OPERATIONS

- A. Furnish, install and place into operation a Rescue Assistance System for this building as indicated on the drawings and as specified herein.
- B. A common annunciator shall be provided at the main building entrance where shown on the drawings to indicate light and tone signals from multiple remote call stations.
 - 1. When system is operational, green LED signals power.
 - 2. When the call station switch is activated, a red LED button illuminates and a one shot tone sounds.
 - 3. When the alarm signal is acknowledged, the remote call station is signaled with a flashing light and tone.
 - 4. Voice communication with the remote call can then be initiated from the annunciator.
 - 5. Access to a public telephone system shall be provided.

PART 2 - PRODUCTS

2.1 RESCUE ASSISTANCE-VISUAL EQUIPMENT

- A. Manufacturer: Cornell Communications, Inc.
 - 1. Contact: 7915 N 81st St., Milwaukee, WI 53223-3830; Telephone: 800- 558-8957; (414) 351-4660; Fax: (414) 351-4657.

2.2 PRODUCT SUBSTITUTIONS

- A. Substitutions: Other products may be used if accepted as an “approved equal” by the Engineer.

2.3 CORNELL 4200 RESCUE ASSISTANCE-AUDIO/VISUAL SYSTEM AND COMPONENTS

- A. Equipment
 - 1. This system shall consist of multiple remote call stations, which will share a common annunciator panel and access to a public telephone system for external alarm notification.
- B. Annunciator
 - 1. When system is operational, green LED signals power.

2. The annunciator panel shall be a CORNELL Model A4208, with capacity for (6) zones, surface mounted at the location specified on the drawings.
 - a. Verify location with the Local Fire Marshal and the Architect.
3. An alternate action switch with internal LED indicator shall be included for each zone.
 - a. A yellow LED light on the zone switch shall illuminate and the alarm shall emit a repeating sound if the supervised wiring is faulted.
4. An audible alarm shall be mounted on the annunciator panel, which will emit a minimum sound level of 90 db at 30 cm when a remote station calls.

Depressing the zone switch will answer a zone and open the intercom line to the zone.
5. The front panel shall have silk-screened zone designations and operating directions as well as zone designation strips.
6. The power supply shall be a 120 volt emergency battery backup, CORNELL model B-5243A.
7. The TAK-4200 Series telephone access kit shall be provided to place a call to a designated location via a dedicated public telephone line to notify them of the alarm. Coordinate with the Owner as to where the designated location(s) shall be.

C. Remote Call Stations

1. The remote call station shall be Cornell Model 4201B/VM, with one momentary mushroom switch with LED and loudspeaker. The standard two gang mounting plate shall be flush mounted and may incorporate heavy duty switches and speakers along with stainless steel plates and tamper-proof screws.
2. The station shall have hands free voice communication with the annunciator.
3. The station shall have silk-screened operating instructions.
4. The station shall be flush wall mounted on a 2-gang stainless steel plate with a 48" maximum mounting height for forward reach, and a 54" maximum for side reach.

D. Signage

1. The Room Identification Sign shall be CORNELL Model SN-B Series, with illumination and battery back-up. The sign shall be mounted at each area of rescue assistance, as well as outside each stairwell on each floor containing a remote call station.
2. The Instruction Sign shall be CORNELL Model SN-C Series, with Braille and mounted adjacent to each remote call station.

E. Wiring

1. The wiring shall be CORNELL Model CB-4200, SmartWire Cable.

2.4 SOURCE QUALITY

- A. Source Quality: Obtain rescue assistance equipment and system from a single manufacturer.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.

3.2 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A. Cabling Requirements
 1. Wiring from the annunciator to the call station shall be 22-gauge, 2 conductor shielded audio pair + 3 conductor unshielded.
 2. Wiring from the annunciator to the power supply shall be 18-gauge, 2 conductor.
 3. Verify cable types with the Rescue Assistance System Manufacturer.
 4. The telephone access kit requires a 120V AC outlet and dedicated external telephone line.
- B. Rescue Assistance Signal System - Audio/Visual Installation
 1. Complete system shall be installed in strict accordance with manufacturer's recommendations.
 2. Wiring shall be installed in raceways from back box to above accessible corridor ceiling. Conduit shall be 3/4" minimum.

3.4 FIELD QUALITY REQUIREMENTS

- A. Site Tests (Post Installation Testing): Checkout final connections to the system shall be made by a factory technician authorized by the manufacturer of the products installed.
 1. Factory authorized technicians shall demonstrate operation of the complete system and each major component to the staff.
 2. System field wiring diagrams shall be provided to this subcontractor by the system prior to installation.
- B. Inspection: Perform a complete functional test of the system upon completion of the installation and instruct the staff in the operation and maintenance of the system.

3.5 CLEANING

- A. Cleaning: Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project site and legally dispose of debris.

--- E N D ---

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Clearing and grubbing site and street right-of-way.
- B. Disposing of removed material

1.2 RELATED WORK

- A. Section 31 20 00 – Earth Moving.

1.3 SUBMITTALS

- A. See Related Work

PART 2 - PRODUCTS

- A. No Products included

PART 3 - EXECUTION

3.1 SITE PREPARATION & PROTECTION

- A. Protection of Existing Improvements.
 - 1. Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
 - 2. Protect improvements on adjoining properties.
 - 3. Restore damaged improvements to their original condition, as acceptable to Architect/Engineer or other parties having jurisdiction.
- B. Protection of Existing Trees and Vegetation:
 - 1. Protect existing trees and other vegetation, indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.
 - 2. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.

3. Repair or replace trees and vegetation indicated to remain which are damaged by construction operations, in manner acceptable to the Architect/Engineer. Employ qualified tree surgeon/arborist to repair damage to trees and shrubs.

3.2 SITE CLEARING

- A. General: clear street right-of-way construction areas of vegetation, improvements, debris, or other obstructions interfering with installation of new construction. Remove such items elsewhere on site or premises as specifically indicated. Removal includes digging out and roots.
- B. Removal of Improvements: Remove above-grade and below-grade improvements necessary to permit construction, and other work as indicated.
- C. Abandonment or removal of certain underground pipe or conduits may be shown on mechanical or electrical drawings, and is included under work of this section. Removal of all other abandoned underground piping or conduit interfering with construction is included under this section.

3.3 DISPOSAL OF WASTE MATERIALS

- A. Burning is not permitted on Owner's property.
- B. Remove cleared waste materials from Owner's property and dispose of at an off site location secured by the contractor.

END OF SECTION

SECTION 31 20 00

EARTH MOVING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Stripping and stockpiling surface layer of topsoil and organic matter in building and traffic areas and in all cut and fill areas.
- B. Removing and disposing of material unsuitable for use in controlled fill.
- C. Excavating site to required subgrade for controlled fill and grading site to required slopes.
- D. Placing and compacting excavated material and borrow material to required density and at required subgrade and slope for structures, pavement areas, and other controlled fills.

1.2 RELATED WORK

- A. Section 31 22 16 – Fine Grading.
- B. Section 33 05 16 – Manholes and Structure.

1.3 REFERENCE STANDARDS

- A. ASTM D422 – Particle Size Analysis of Soils.
- B. ASTM D4318 – Test for Liquid Limit of Soils.
- C. ASTM D4318 – Test for Plastic Limit of Soils.
- D. ASTM D2216 – Method of Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures.
- E. ASTM D3017 – Moisture Content on Soil Aggregates in Place by Nuclear Methods (Shallow Depth).
- F. ASTM D698 – Standard Test Method for Moisture Density, Relations of Soils, and Soil Aggregate Mixtures Using 5.5 lb Rammer and 12” Drop.
- G. ASTM D1557 – Standard Test Methods for Moisture Density Relations of Soils and Soil Aggregate Using 10 lb. Rammer and 18” Drop.
- H. ASTM D2922 – Density of Soil and Soil Aggregates in Place by Nuclear Method (Shallow Depth).

1.4 SUBMITTALS

- A. See Related Work

1.5 SITE CONDITIONS

- A. Establish positive surface drainage during and following clearing and grading activities using proper ditching and sloping methods.
- B. Provide erosion control measures to prevent mud and slit from flowing onto adjacent property.
- C. Erect sheeting, shoring, and bracing as necessary for protection of persons, utilities improvements, and excavations.

PART 2 - PRODUCTS

2.1 SUITABLE MATERAILS FOR CONTROLLED FILL

- A. On site excavated soils:
 - 1. Unified Soils Classification Systems Soils.
 - a. Class SC
 - b. Class GC
 - c. Class CL
 - 2. Soils having Liquid Limit of less than 45, Plasticity Index (PI) of 20 or less.
 - 3. Other soils approved by the Engineer.
- B. Borrow Material:
 - 1. Soils meeting the requirements of sub-paragraph A.1 of this Article.

2.2 UNSUITABLE MATERIAL FOR CONTROLLED FILL

- A. All areas: Organic top soils, soils containing roots, vegetable matter, or trash, and silts (ML) and clays (CH), and cobbles and fractured rock more than 3 inches in greatest dimension.

PART 3 - EXECUTION

3.1 SUBSURFACE INVESTIGATION

- A. The Contractor is responsible for having a thorough knowledge of all Drawings, Specifications, General and Supplementary Conditions, existing site conditions, and other Contract Documents. Failure to acquaint himself with this knowledge does not relieve him of the responsibility for performing his work in a manner acceptable to the Owner. No additional compensation will be allowed because of conditions that occur due to failure by the Contractor to familiarize himself and all workers with this knowledge.
- B. Protection of Existing Trees and Vegetation:

1. Protect existing trees and other vegetation, indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.
2. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.
3. Repair or replace trees and vegetation indicated to remain which are damaged by construction operations, in manner acceptable to the Architect/Engineer. Employ qualified tree surgeon to repair damage to trees and shrubs.

3.2 PREPARATION

- A. Complete clearing work, removing visible unsuitable materials from site.
- B. Protect benchmarks, site corner pins and existing street paving from damage by equipment.
- C. Stake the work:
- D. Before starting the excavation, establish location and extent of underground utilities occurring in work area.
- E. Notify utility companies of lines which are in the way of excavation.
- F. Protect existing utility lines to remain which pass through the work area.
- G. Protect utility services uncovered by excavation.
- H. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
- I. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

3.3 EXCAVATION PROCEDURES

- A. Excavation General:
 1. Strip topsoil in cut and fill areas to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove and dispose of heavy growth of grass and surface debris from areas prior to stripping topsoil.
 - a. Where trees are indicated to be left standing, stop topsoil stripping a sufficient distance to prevent damage to main root system.
 2. Stockpile topsoil in storage piles in areas shown, or where directed. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent wind-blown dust.

3. Remove soft or spongy material at the exposed sub-grade of cut and fill areas and replace with approved material and compact.
4. Use all suitable excavated material, as far as practicable, in the formation of controlled fills and fill slopes.
5. Keep all excavations dry by pumping or draining water from the Work.
6. In cut areas where fill is not required proof roll the areas with a loaded tandem axle dump truck or similar equipment to aid in identifying soft areas. Remove soft soils and replace with controlled fill. Scarify exposed sub-grade soils to a depth of at least 8 inches, adjust the soil mixture, and recompact to the same density as required for each layer of controlled fill.
7. Grade excavated slopes to a neat, smooth condition with no loose material or scars left on the surface.
8. Dispose of debris, excess topsoil, excess fill material and unsuitable material at an off site location secured by the contractor.

3.4 CONTROLLED FILL

- A. After excavation and before fill placement, proof roll fill areas with a loaded tandem axle dump truck or similar equipment to aid in identifying soft areas. Remove soft areas and replace with controlled fill.
- B. Scarify cleared surface in fill areas to a depth of at least 8 inches, adjust the soil mixture, and recompact to the same density as required for each layer of controlled fill.
- C. Place fill material in lifts no greater than 8-inch loose-lift uniform thickness and compact to 95% MAX Dry Density as determined by the Modified Proctor Test, ASTM D1557.
 1. Aerate material when too wet by manipulation with suitable equipment before compacting.
 2. Add water when soil is too dry and mix with the material before compacting.
- D. Complete excavation and controlled fill to within 3 inches of finish grade in all landscape and turf areas.

3.5 FIELD QUALITY CONTROL

- A. Field density tests will be performed per ASTM D6938.
- B. Frequency of Tests:
 1. Tests shall be made every day fill is being placed and representative lifts tested.
 2. At least one test per 2,500 sq. ft. under buildings and structural areas.

3. At least one test per 5,000 sq. ft. under paved areas.
4. At least one test per 10,000 sq. ft. in general areas.
5. Contractor to notify engineer when fill work is in progress.
6. Test locations will be selected at random by engineer with an effort made to select areas of questionable compaction.
7. Retesting required because of nonconformance to specified requirements shall be performed by the same agency on instruction from the engineer.
8. Retesting required because of nonconformance to specified requirements shall be paid for by the contractor. Payment for retesting or re-inspection will be charged to the contractor by deducting testing charges from the contract sum/price.

END OF SECTION

SECTION 31 22 16

FINE GRADING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Stripping and stockpiling surface layer of topsoil and organic matter in all cut and fill areas.
- B. Excavating and grading open drainage ditches.
- C. Placing and compacting excavated material or borrow material to required density and at required subgrade and slope for roadway embankment and other compacted fills.
- D. Removing and disposing of excess excavated material.

1.2 RELATED WORK

- A. Section 31 22 00 – Earth Moving.
- B. Section 33 05 16 – Manholes and Structure.

1.3 SUBMITTALS

- A. See Related Work

1.4 SITE CONDITIONS

- A. Establish positive surface drainage during and following stripping, embankment construction, and roadway grading by proper ditching or slopping.
- B. Provide measures to prevent mud and silt from flowing onto adjacent property.
- C. Erect sheeting, shoring, and bracing as necessary for protection of persons, improvements, and excavations.

PART 2 - PRODUCTS

2.1 SUITABLE MATERIAL FOR COMPACTED EMBANKMENT

- A. Select fill consisting of sandy clay, clayey sand or clayey gravel having a liquid limit less than 40.
- B. On-site excavated soils meeting the requirements of Paragraph A above.
- C. Material meeting the requirements of selected material as described in Section 210 of the Arkansas State Highway Department's Standards Specifications for Highway Construction, Edition of 2003.

2.2 UNSUITABLE MATERIAL FOR COMPACTED EMBANKMENT

- A. All areas: Organic topsoil's, soils containing roots, vegetable matter, or trash, and cobbles and fractured rock more than 3 inches in greatest dimension.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove visible unsuitable materials from the site before beginning stripping and site grading operation.
- B. Notify Architect/Engineer when work is ready to be staked.
- C. Notify the geotechnical engineer representing the Owner's selected testing laboratory at least 48 hours before planned time to begin placing embankment material.

3.2 EXCAVATION PROCEDURES

A. Excavation, General:

1. Strip topsoil in cut and fill areas to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove and dispose of heavy growth of grass and surface debris from areas prior to stripping topsoil.
 - a. Where trees are indicated to be left standing, stop topsoil stripping a sufficient distance to prevent damage to main root system.
2. Stockpile topsoil in storage piles in areas shown, or where directed. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent wind-blown dust.
3. Remove soft or spongy material at the exposed sub-grade of cut and fill areas and replace with approved material and compact.
4. Use all suitable excavated material, as far as practicable, in the formation of controlled fills and fill slopes.
5. Keep all excavations dry by pumping or draining water from the work site.
6. Grade excavated slopes to a neat, smooth condition with no loose material or scars left on the surface.
7. Protect existing asphalt paving and structures designed to remain from drainage by excavation and grading operations.
8. Dispose of debris, excess topsoil, excess fill material and unsuitable material at an off site location secured by the contractor.

B. Excavation, roadway:

1. Excavate and grade to within ± 0.1 foot of required subgrade elevations.
2. Grade back slopes to the slope shown on the Drawings.
3. Remove soft or spongy material at the exposed subgrade of cut and fill areas and replace with select material and compact to the same density as required for compacted fill. Identify soft areas by proof rolling with a loaded tandem axle dump truck or similar equipment.
4. DO not allow subsoil in roadbed area to become saturated. Maintain positive surface drainage during and following excavation, grading, and filling operations.
5. Where compacted fill is required, scarify stripped surface to a depth of at least 8 inches, adjust the soil moisture, and recompact to the same density as required for each layer of compacted fill.

3.3 COMPACTED EMBANKMENT

- A. Start embankment full width of bottom of embankment cross-section and construct to specified grade over full width in uniform layers.
- B. Place fill material in lifts no greater than 8 inch loose-lift uniform thickness and compact to a minimum of 95% of maximum dry density at or near optimum moisture content as determined by the Modified Compaction Procedures, ASTM D1557.
 1. Add Water when soil is too dry and mix the material before compacting.
 2. Aerate material when too wet by manipulation with suitable equipment before compacting.
- C. Do not place next lift until the in-place density and moisture content of the preceding lift has been verified.
- D. Geotechnical engineer will inspect and test soil for suitability for use in embankment and for need to perform additional "Proctors" as soil composition changes during progress of excavation. Do not compact layer of soil that geotechnical engineer has determined to be a "change in soil composition" until it has been determined to be suitable and a "Proctor" has been run.
- E. Coordinate with the geotechnical engineer and provide the necessary assistance to perform the tests. Initial soil testing costs shall be paid for as outlined in the testing specification of the front end documents. Should the tests be unsatisfactory, the Contractor shall be responsible for obtaining and paying for additional tests, which will be performed by an independent laboratory approved by Owner and Engineer.
- F. Maintain stability of compacted embankment. Replace or repair portions which have eroded due to elements or to Contractor negligence.

- G. Grade for slopes and other embankment areas not to be paved, to neat, smooth conditions with no loose material or scars left on surface. Fill and grade slopes to within three inches of finish grade elevations to allow for topsoil, sod and other landscaping.

3.4 PROTECTION

- A. As soon as embankment is completed, proceed with riprap work and notify architect/Engineer that slopes are ready for erosion protection by landscaping contractor.

END OF SECTION

SECTION 31 23 16

EXCAVATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Excavating rock encountered during trenching for utility lines and excavating for manholes by mechanical methods. Blasting is not allowed.
- B. Disposing of excavated rock material.

1.2 RELATED WORK

- A. Section 33 11 00 – Water Utility Distribution Piping.
- B. Section 33 31 00 – Sanitary Utility Sewerage Piping.
- C. Section 33 39 00 - Sanitary Utility Sewerage Structures.

1.3 SUBMITTALS

- A. See Related Work

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Definition of rock: All solid rock formation that, in the opinion of the Engineer, cannot be excavated by using power shovels or other power excavators which are of recognized manufacture and design, of adequate size and operated by qualified operators without continuous and systematic blasting, barring or wedging. It shall include boulders or pieces of detached rock exceeding one cubic yard in volume and solid rock formations which are interspersed with strata of clay or other material provided however that the solid rock constitutes at least 75% of the total volume of the particular formation. The conventional heavy-duty excavating equipment may be defined as a Caterpillar D-8 bulldozer with single tooth ripper, a Caterpillar 325 track excavator equipped with rock teeth, or equipment of similar power and capability. Rock excavation volumes should be determined based on in-place measurements via cross sectioning. If excavation is to be unclassified, the contractor must be responsible for assessing rock excavation requirements.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify site conditions and note irregularities affecting work of this section.

- B. Beginning work of this section means acceptance of existing condition.

3.2 ROCK EXCAVATION – GENERAL

- A. Excavate rock encountered in excavating for manholes and trenching for water and sewer lines.
- B. De-watering: Provide temporary adequate de-watering equipment to keep excavations free of standing water during rock excavation.

3.3 ROCK EXCAVATION – MECHANICAL METHOD

- A. Excavate for and remove rock by the mechanical method.
- B. Cut away rock at excavation bottom to form level bearing.
- C. Remove shaled layers to provide sound and unshattered base for subgrade levels.
- D. Remove Excavated Material from Site.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This work shall consist of temporary erosion control measures needed to control erosion and water pollution, through the use of berms, sediments basins, sediments dams, silt fences, silt dikes, and temporary seeding.
- B. Temporary erosion control measures shall be performed promptly when problems occur or when potential problems are anticipated in certain areas in order to minimize soil erosion. The temporary erosion control measures shall be properly maintained until permanent erosion control features are functioning properly.
- C. The Contractor shall comply with all Federal, State, and Local laws and regulations controlling pollutions of the environments. The Contractor shall take necessary precautions to prevent pollution of streams, lakes, ponds and reservoirs with fuel, oils, bitumens, chemicals, soil sedimentation or other harmful materials and to prevent pollution of the atmosphere from particulate gaseous matter.

1.2 RELATED WORK

- A. Section 31 11 00 –Clearing and Grubbing
- B. Section 31 20 00 – Earth Moving

1.3 SUBMITTALS

- A. See Related work

1.4 QUALITY ASSURANCE

- A. Prior to start of the construction, the Contractor shall submit, to the Owner and Engineer, his schedule for temporary and permanent erosion control work based on the Engineer's erosion control base plan, as is applicable for clearing & grubbing, grading and trenching. The location of the project, type of soil, topography and proximity to watercourses shall be considered when imposing such limitations.

PART 2 - PRODUCTS

2.1 FILTER FABRIC

- A. The filter fabric for silt fence shall be as indicated on the drawings.

PART 3 - EXECUTION

3.1 PERMITTING

- A. The Contractor shall file the Notice of intent to discharge storm water associated with the planned construction activity in accordance with the State of Arkansas NPDES General Permit ARR10A000 48 hours before starting construction. The Contractor shall develop a Storm Water Pollution Prevention Plan (SWPPP) document for submittal to ADEQ.

3.2 EROSION CONTROL

- A. The Contractor shall schedule and conduct his operations in such a manner as to insure good erosion control practices so as to minimize soil erosion and prevent the contamination of and depositing of sediment in adjacent streams or other water courses, lakes, ponds, and other areas of water impoundment. Temporary erosion control measures which will contribute to the control of erosion and sedimentation shall be carried out in conjunction with clearing & grubbing, grading, and trenching operations.
- B. Permanent erosion control devices or measures shall consist of culvert pipe, terraces, gutters, bituminous curb, sectional drains, permanent slope drains, and the establishment of permanent vegetation (seeding), and when included in the contract they shall be incorporated in the construction with the least delay. Trenched areas shall be seeded as the excavation proceeds to the extent considered necessary by the Engineer as desirable or practicable.
- C. The Contractor shall also conform to the following practices and controls:
 - 1. When the material is trenched, erosion of the slopes shall be controlled both during and after completion of the work, that erosion will be minimized and sediment will not enter streams, wetlands or other bodies of water. Haul roads shall be located and constructed in a manner that will keep sediment from entering streams.
 - 2. Pollutants such as fuels, lubricants, bitumens, raw sewage and other harmful materials shall not be discharged into or near rivers, streams or impoundments or into natural or man made channels leading thereto. Wash water or waste from concrete mixing operation shall not be allowed to enter live streams.
 - 3. All applicable regulations of agencies and statutes relating to the prevention and abatement of pollution shall be complied within the performance of the contract.
- D. All temporary erosion and sediment control structures shall be constructed in accordance with the Storm Water Pollution Prevention Plan. All temporary structures shall be maintained in proper operating condition during the construction period. The temporary structures shall be removed and the site cleaned up only after the end of the construction activity and the seeding and fertilizing operation has been completed and the grass has been established.
- E. The contractor shall follow the general guidelines for placement of erosion and sediment control as indicated on the Erosion Control Plan as part of his SWPPP. The Contractor shall add any required additional erosion and/or sediment control devices as necessary to control erosion and

sediment on the project site. The contractor shall use the Engineer's erosion control plan to comply with the SWPPP and it shall include as a minimum the following items:

1. Time scheduling for the various phases of the work designed to limit the time between the clearing and the temporary seeding and fertilizing to a reasonable period of time.
2. Temporary erosion control measures shall be included in the plan in accordance with the temporary erosion control details as included on the Erosion Control Plan.
3. A time schedule shall be included in the plan detailing when each erosion control structure shown on the plans is to be constructed. Each structure should be constructed as soon as practical after access to the site has been achieved and prior to major grading operations.

Temporary erosion control structures shall be maintained to function satisfactorily and all sediment and debris removed and disposed of in a manner acceptable to the Engineer.

3.3 INSPECTION

- A. The Contractor shall appoint a qualified person(s) to conduct regularly scheduled inspections during his contract. Inspections shall be conducted, with a minimum frequency of every seven (7) calendar days or within 24 hours following the end of at least a 0.5 inch (1/2 inch) rainfall event, whichever is earliest. During the inspection, the following areas (as a minimum) will be inspected:
 1. Disturbed Areas – All areas of disturbed soil i.e. bare soil with no ground cover shall be inspected for signs of washing and erosion.
 2. Material Storage Area – All central storage areas where materials/chemicals are stored for signs of spill, leaks and possible contamination.
 3. Erosion and Sediment Control Measures – Inspect all erosion and sediment control measures for signs of wear, damage, remaining capacity level, usefulness, etc.
 4. Discharge Locations – Immediately following, and possibly during a significant rainfall event, inspect all discharge locations to ascertain the effectiveness of the control measures.
 5. Entrance/Exit Locations – Inspect all exit points from the site for evidence of vehicle tracking.

The inspector shall complete an inspection form for each inspection performed. As a minimum, the inspection form shall contain the following information:

- o Name and location of project.
- o Name and title of the inspector.
- o Date and time of the inspection.
- o Condition of each of the above locations.

3.4 MAINTENANCE OF ROADWAYS

- A. The existing paved roadways adjacent to the permitted entrance locations shall be maintained in a clean and passable condition by the Contractor. When required or as requested by the Owner of the Engineer, the Contractor shall broom or wash the existing paved roadways to remove excess mud or dirt at the intersection and for a reasonable length of the existing roadway beyond the intersection. The work shall not be paid for directly, but shall be considered incidental to the other items of work and the cost included as a part of the work.

3.5 PAYMENT

- A. Payment for the work in this section shall be included as part of the lump sum contract.

END OF SECTION

SECTION 313116
TERMITE CONTROL

PART 1 - GENERAL

1.1 GENERAL

- A. Green Globes™ Requirements
 - 1. Develop an Integrated Pest Management (IPM) Plan. Include the following:
 - a. Facilities shall be designed and maintained to minimize the requirement for pesticide usage and chemical controls, taking into consideration local conditions.
 - b. Landscaping shall use pest-resistant plants.
- B. Section Includes:
 - 1. Soil treatment with termiticide.
 - 2. Polymer barrier fittings with termiticide for installation around utility penetrations.

1.2 RELATED SECTIONS:

- 1. Section 03 30 00, CAST-IN-PLACE CONCRETE, for concrete slab-on-grade.
- 2. Section 06 10 00 "ROUGH CARPENTRY" for wood preservative treatment by pressure process.

1.3 SUBMITTALS

- A. Product Data: For each type of termite control product.
 - 1. Include the EPA-Registered Label for termiticide products.
- B. Qualification Data: For qualified Installer.
- C. Product Certificates: For termite control products, from manufacturer.
- D. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:
 - 1. Date and time of application.
 - 2. Moisture content of soil before application.
 - 3. Termiticide brand name and manufacturer.
 - 4. Quantity of undiluted termiticide used.
 - 5. Dilutions, methods, volumes used, and rates of application.
 - 6. Areas of application.
 - 7. Water source for application.
- E. Warranties: Sample of special warranties.

1.4 SUSTAINABILITY CONSIDERATIONS:

- A. This project is designed and constructed with practices and procedures to meet the project's sustainability considerations and goals. These considerations and goals are to establish a facility which maximizes sustainability, profitability, and the health of all occupants. In order to fulfill these goals, this project is pursuing a Green Building Institute's Green Globes™ certification of Two Globes. Refer to sections listed below for sustainability considerations and goals, and applicable paragraphs of this specification section. The Contractor shall ensure that the requirements related to these considerations and goals, as defined in the Contract Documents, are implemented to the fullest extent.
 - 1. Section 01 81 11 SUSTAINABLE DESIGN REQUIREMENTS.
 - 2. Section 01 81 13 SUSTAINABLE DESIGN REQUIREMENTS for GREEN GLOBES™ CERTIFICATION.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment in jurisdiction where Project is located, and who employs workers trained and approved by manufacturer to install manufacturer's products.
- B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.
- C. Source Limitations: Obtain termite control products from single source from single manufacturer.
- D. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
- B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is

discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

- A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.
 1. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
 1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.
 - 1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 - 2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
 - 3. Masonry: Treat voids.
 - 4. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
- B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- D. Post warning signs in areas of application.
- E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

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SECTION 31 63 27 DRILLED PIERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes dry-installed drilled piers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.
- C. Shop Drawings: For concrete reinforcement.
- D. Material certificates and test reports.

1.3 QUALITY ASSURANCE

- A. Drilled-Pier Standard: Comply with ACI 336.1 unless modified in this Section.

1.4 PROJECT CONDITIONS

- A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for drilled piers.
 - 2. The geotechnical report is included elsewhere in the Project Manual.
- B. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
 - 1. Record and maintain information pertinent to each drilled pier and cooperate with Owner's testing and inspecting agency to provide data for required reports.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

- C. Plain-Steel Wire: ASTM A 82, as drawn.

2.2 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I or Type II
 - a. Fly Ash: ASTM C 618, Class C or Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregate: ASTM C 33, graded, 3/4-inch- (19-mm-) nominal maximum coarse-aggregate size.
 - 1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.
- D. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 3. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 4. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.3 STEEL CASINGS

- A. Steel Pipe Casings: ASTM A 283/A 283M, Grade C, or ASTM A 36/A 36M, carbon-steel plate, with joints full-penetration welded according to AWS D1.1/D1.1M.

2.4 CONCRETE MIXTURES AND MIXING

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.
- C. Chloride-ion admixture is prohibited.
- D. Proportion normal-weight concrete mixture as follows:
 - 1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).

- 2. Air Content: Do not air entrain concrete.
- E. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Unclassified Excavation: Excavate to bearing elevations regardless of character of surface and subsurface conditions encountered.
- B. Classified Excavation: Excavation is classified as standard excavation, special excavation, and obstruction removal and includes excavation to bearing elevations as follows:
 - 1. Standard excavation includes excavation accomplished with conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work.
 - 2. Special excavation includes excavation that requires special equipment or procedures above or below indicated depth of drilled piers where drilled-pier excavation equipment used in standard excavation, operating at maximum power, torque, and downthrust, cannot advance the shaft.
 - 3. Obstructions: Payment for removing unanticipated boulders, concrete, masonry, or other subsurface obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work will be according to Contract provisions for changes in the Work.
- C. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.
- D. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.
 - 1. Do not excavate shafts deeper than elevations indicated unless approved by Architect.
 - 2. Payment for additional authorized excavation will be according to Contract provisions for changes in the Work.
- E. End-Bearing Drilled Piers: Probe with auger to a depth below bearing elevation, equal to diameter of the bearing area of drilled pier. Determine whether voids, clay seams, or solution channels exist.
- F. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.

1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete[, or leave temporary casings in place].
- G. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.

3.2 INSTALLATION

- A. Install steel casings of minimum wall thickness indicated and of diameter not less than diameter of drilled pier.
- B. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- C. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner's independent testing and inspecting agency.
- D. Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement. Vibrate top 60 inches (1500 mm) of concrete.
- E. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch (1500-mm) head of concrete above bottom of casing. Vibrate top 60 inches (1500 mm) of concrete after withdrawal of temporary casing.

3.3 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 1. Drilled piers.
 2. Excavation.
 3. Concrete.
 4. Steel reinforcement placement.
- B. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.
- C. Drilled-Pier Tests and Inspections: For each drilled pier, before concrete placement.
 1. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths and bearing capacities will be determined by testing and inspecting agency. Final evaluations and approval of data will be determined by Architect.
- D. Concrete Tests and Inspections: ACI 301.

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SECTION 32 01 90

OPERATION AND MAINTENANCE OF PLANTING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This Section includes the protection and trimming of trees that interfere with, or are affected by execution of the work, whether temporary or new construction.

1.2 RELATED WORK

- A. Drawings and general provisions of the contract, including General and Supplementary conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 01 11 00 – Summary of Work, for limits places on Contractor's use of the site.
- C. Section 31 11 00 – Clearing & Grubbing
- D. Section 31 20 00 – Earth Moving

1.3 REFERENCES

- A. Product Data: For each type of product indicated.
- B. Qualification Data: for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, name and address of architects and owners, and other information specified.
- C. Certification: From a qualified arborist that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- D. Maintenance Recommendations: from a qualified arborist for care and protection of trees affected by construction during and after completing the work.

1.4 SUBMITTALS

- A. See Related Work

1.5 QUALITY ASSURANCE

- A. Tree Service Qualifications: An experienced tree service firm that has successfully completed tree protection and trimming work similar to that required for this Project and that will assign an experienced, qualified arborist to project site on a full-time basis during execution of the Work.
- B. Arborist Qualifications: An arborist certified by the International Society of Arboriculture or licensed in the jurisdiction where Project is located.

- C. Tree Pruning Standards: Comply with ANSI A 300, "Trees, Shrubs, and other Woody Plants Maintenance –Standards Practices", unless more stringent requirements are indicated.
- D. Pre-installation conference: conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings".
 - 1. Before starting tree protection and trimming, meet with representatives of authorities having jurisdiction, Owner, Architect, consultants, and other concerned entities. Review tree protection and trimming procedures and responsibilities. Notify participants at least three working days before convening conference. Record discussions and agreements and furnish a copy to each participant.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Drainage Fill: Selected crushed stone, or crushed or uncrushed gravel, washed, ASTM D 448, size 24, with 90 to 100 percent passing a 2 -1/2 inch (63mm) sieve and not more than 10 percent passing a 3/4 inch (19mm) sieve.
- B. Topsoil: Fertile, friable, surface soil, containing natural loam and complying with ASTM D 5268. Provide topsoil that is free of stones larger than 1 inch in any dimension and free of other extraneous or toxic matter harmful to plant growth. Obtain topsoil only from well-drained sites where soil occurs in depth of 4 inches or more; do not obtain from bogs or marshes.
- C. Filter Fabric: Manufacturer's standard, nonwoven, pervious, geotextile fabric of polypropylene, nylon, or polyester fibers.
- D. Chain Link Fence: Metallic-coated steel chain link fence fabric, 0.120-inch diameter wire size; 48 inches high, minimum; line posts, 1.9 inches in diameter; terminal and corner posts, 2-3/8 inches in diameter; top rail, 1-5/8 inches in diameter; bottom tension wire, 0.177 inches in diameter; with tie wires, hog ring ties, and other accessories for a complete fence system.
- E. Tree Protection Fencing:
 - 1. Wire Stringer-12 gauge galvanized wire, top and bottom of fence, tied to T-post.
 - 2. T-posts –6 1/2 foot; green with white tops.
 - 3. Orange Safety Fencing-Attach to posts, top and bottom and at top of fencing at approximate mid-point between posts with 12 gauge galvanized wire ties.
- F. Sharp Sand: ASTM C-33 for fine aggregate
- G. Tree Paint: Thompson Tree Seal, Cabot Tree Paint or approved equal.
- H. Antiseptic: Antiseptic shall consist of a mixture of one pound copper sulfate to one gallon of boiled linseed oil.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Temporary Fencing: Install temporary fencing located as indicated or outside the drip line of trees to protect remaining vegetation from construction damage.
 - 1. Install chain link fence according to ASTM F 567 and manufacturer's written instructions.
- B. Protect tree root systems from damage due to noxious materials caused by runoff or spillage while mixing, placing, or storing construction materials. Protect root systems from flooding, eroding, or excessive wetting caused by dewatering operations.
- C. Do not store construction materials, debris, or excavated material within the drip line of remaining trees. Do not permit vehicles or foot traffic within the drip line; prevent soil compaction over root systems.
- D. Do not allow fires under or adjacent to remaining trees or other plants.
- E. "Price Tags" noting the value of each tree shall be hung on the branches of each tree to be saved every 10' along the outer edge of the tree. These price tags shall be 5.5"x17" (half of an 11x17 sheet) with the dollar amount printed in a 250pt bold Arial font. The price tags are to be laminated and then hung from the trees using zip ties. Price of individual trees to be determined on site by landscape architect after initial clearing has been completed.

3.2 EXCAVATION

- A. Install shoring or other protective support systems to minimize sloping or benching of excavations.
- B. Do not excavate within drip line of trees, unless otherwise indicated.
- C. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks and comb soil to expose roots.
 - 1. Relocate roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and relocate them without breaking. If encountered immediately adjacent to location of new construction and relocation is not practical, cut roots approximately 3 inches back from new construction.
 - 2. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
- D. Where utility trenches are required within drip line of trees, tunnel under or around roots by drilling, auger boring, pipe jacking, or digging by hand.

1. Root Pruning: Do not cut main lateral roots or taproots: cut only smaller roots that interfere with installation of utilities. Cut roots with sharp pruning instruments: do not break or chop.

E. Where trenching is required elsewhere on site:

1. Trenching shall be performed by the approved trencher, cutting any and all roots completely and cleanly. Tearing, shredding or pulling of the roots shall not be permitted.
2. Treat cut roots with antiseptic only, immediately after trenching.
3. Fill trench to existing grade with sharp sand, compact and water thoroughly.

3.3 REGRADING

- A. Grade Lowering: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by qualified arborist, unless otherwise indicated.
 1. Root Pruning: Prune tree roots exposed during grade lowering. Do not cut main lateral roots or taproots: cut only smaller roots. Cut roots with sharp pruning instruments; do not break or chop.
- B. Minor Fill: where existing grade is more than 6 inches or less below elevation of finish grade fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.
- C. Moderate Fill: Where existing grade is more than 6 inches, but less than 12 inches, below elevation of finish grade, place drainage fill, filter fabric, and topsoil on existing grade as follows:
 1. Carefully place drainage fill against tree trunk approximately 2 inches above elevation of finish grade and extend not less than 18 inches from trunk on all sides. For balance of area within drip-line perimeter, place drainage fill up to 6 inches below elevation of grade.
 2. Place filter fabric with edges overlapping 6 inches minimum.
 3. Place fill layer of topsoil to finish grade. Do not compact drainage fill or topsoil. Hand grade to required finish elevations.

3.4 TREE PRUNING

- A. Prune remaining trees affected by temporary and new construction.
- B. Prune remaining trees to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by qualified arborist.
- C. Pruning Standards: Prune trees according to ANSI A 300 as follows:

1. Type of pruning: Crown Cleaning.
2. Type of pruning: Crown thinning.
3. Type of pruning: Crown raising.
4. Type of pruning: Crown reduction.
5. Type of pruning: Vista pruning.
6. Type of pruning: Crown restoration.

D. Cut branches with sharp pruning instruments; do not break or chop.

3.5 TREE REPAIR AND REPLACEMENT

- A. Promptly repair trees damaged by construction operations within 24 hours. Treat damaged trunks, limbs, and roots according to written instructions of the qualified arborist.
- B. Remove and replace dead and damaged trees that the qualified arborist determines to be incapable of restoring to a normal growth pattern.
 1. Provide new trees of the same size and species as those being replaced: Plant and maintain as specified in Division 2 Section "Trees, Shrubs & Ground Cover."
 2. Provide new trees more than 6-inch caliper size and of species selected by Architect when trees more than 6 inches in caliper size, measured 12 inches above grade, are required to be replaced.
- C. Aerate surface soil, compacted during construction, 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch diameter holes a minimum of 12 inches deep at 24 inches o.c. Backfill holes with an equal mix of augered soil and sand.

3.6 DISPOSAL OF WASTE MATERIALS

- A. Burning is not permitted.
- B. Disposal: Remove excess excavated material, displaced trees, and pruned branches from Owner's property.

3.7 CLEAN UP AND REMOVAL OF TREE PROTECTION FENCING

- A. Remove and dispose of tree protection fencing and stakes when site is ready for seeding. If other trades will be working in the area, tree fencing is to remain until they complete their work.

END OF SECTION

SECTION 32 05 23

CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Formwork, complete with required shoring, bracing and anchorage.
- B. Control joints and expansion joints.
- C. Concrete joints and expansion joints.
- D. Cast-in-place concrete.

1.2 RELATED WORK

- A. Section 01 45 29 – Testing Laboratory Services.
- B. Section 32 13 73 – Concrete Paving Joint Sealants
- C. Section 32 13 76 - Sidewalks
- D. Section 33 05 16 – Manholes and Structures.
- E. Section 33 40 00 – Storm Drainage Utilities.

1.3 SUBMITTALS

- A. See Related Work

1.4 QUALITY ASSURANCE

- A. Perform cast-in-place concrete work in accordance with ACI 301, unless specified otherwise in this Project Manual.
- B. Keep copy of ACI 301-99 in field office for duration of project.

1.5 TESTING AGENCY

- A. Field testing of the concrete mix will be performed by an independent testing laboratory in accordance with Sections 01 45 29.
- B. Provide free access to work and cooperate with the appointed laboratory.
- C. Tests of cement and aggregates may be performed to ensure conformance with requirements state herein.

1.6 REFERENCE STANDARDS

- A. ACI-301-99, Specifications for Structural Concrete.

- B. ACI Manual of Concrete Practice, Parts 1, 2, and 3.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Allowable Concrete Mix Temperatures: ACI 301 -99 Section 4.2.2.7.
 - 1. Cold Weather: Minimum 35 degrees F.
 - 2. Hot Weather: Maximum 95 degrees F.
- B. Do not place concrete during rain, sleet, or snow unless protection is provided.
- C. Keep accurate thermometer in area where work is proceeding.

PART 2 - PRODUCTS

2.1 CEMENT (ACI 301-99 Section 4.2).

- A. Portland Cement: ASTM C150, Type 1.
- B. Use one brand and type of cement throughout project unless otherwise specified.

2.2 ADMIXTURES (ACI 301-99 Section 4.2)

- A. Add air-entraining agent as indicated in ACI 301-99 Section 4.2.1.4.
- B. Use of accelerating admixtures such as salts, chemicals, or other foreign materials in cold weather will not be allowed. Use no other admixtures without prior approval of the Architect/Engineer.
- C. Use of set – retarding admixtures during hot weather will not be allowed.

2.3 STRENGTH (ACI 301-99 Section 1.7.4)

- A. Provide concrete of following strength: Compressive strength (28day): 3,500 psi, except where noted otherwise in the Contract Documents

2.4 AIR ENTRAINMENT (ACI 301-99 Section 4.2.1.4)

- A. Add air-entraining agent to concrete mix for concrete work exposed to exterior.

2.5 SLUMP (ACI 301-99 Section 4.2.2.2)

- A. Contractor shall provide slump cone and test slump for each load of concrete.
- B. Minimum, slump for all concrete work: 3 inches.

- C. Slump for consolidation by vibration: 4 inches maximum.
- D. Slump for slabs and consolidation other than by vibration: 5 inches maximum.

2.6 PROPORTIONS

- A. Selection of proportions for normal weight concrete: Method 1, Method 2, or Method 3, Contractor's Option.
- B. Fine aggregate shall conform to the requirements of ASTM Specification C-33, latest edition, and shall consist of clean, fresh water sand graded uniformly to conform to Paragraph 4 of the above referenced Specification C-33.
- C. Coarse aggregate shall conform to the requirements of ASTM Specification C-33, latest edition, using standard grading size 1 -1/2" to No. 4 of washed gravel or crushed stone meeting requirements above and soundness requirements of ASTM C-33.
- D. Water: Clean and free of injurious amounts of oil, acids, alkalis, organic materials, or other deleterious substances.

2.7 REINFORCING STEEL (ACI 301-99 Section 3)

- A. Reinforcing Steel: 60 ksi yield grade; deformed billet steel bars, ASTM A615; plain finish.
- B. Welded Steel Wire Fabric: plain type, ASTM A 185; in coiled rolls, plain finish, 6x6-W1.4 x W1.4 or 6x6 – W2.9 X W2.9 as shown on the Drawings.

2.8 ACCESSORIES

- A. Premolded expansion joint fillers: ASTM D1751, See plans and details for width / thickness of joint. Refer to ACI 301-99 Section 10.2.5.

2.9 CONCRETE MIX

- A. Mix concrete in accordance with ASTM C94.
- B. Mix concrete until there is a uniform distribution of the materials and the mass is homogeneous in consistency and colors. Continue mixing for at least 1 -1/2 minutes after all the ingredients are in the mixer.

PART 3 - EXECUTION

3.1 GENERAL

- A. Notify Architect/Engineer at least 24 hours before the planned time to pour concrete.
- B. Inspection:

1. Ensure that excavation and formwork are completed and within the allowed tolerances.
 2. Ensure that ice and excess water are removed, no frost is present, and that ground is not frozen.
 3. Check that reinforcement is secured in place.
 4. Verify that insulation, anchors, and other embedded items are secured in position.
- C. Install concrete work in accordance with ACI 301-99 except as amended by this section.

3.2 FORMWORK (ACI 301-99 Section 2)

- A. Obtain Architect/Engineer's review for use of earth forms. When using earth forms, hand-trim sides and bottoms, and remove loose dirt prior to placing concrete.
- B. Tolerances for Formed Services: (Comply with ACI 301-99 Section 2)

3.3 FORM SURFACES PREPARATION (ACI 301-99 Section 2)

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations. Apply prior to placing reinforcing steel, anchoring devices and embedded parts. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent.

3.4 FINISHING FORMED SURFACES

- A. Formed Surfaces Finishes: Provide rough form finish (ACI 301-99 Section 2) at all surfaces not exposed to view. Provide smooth rubbed finished (ACI 301-99 Section 2) at all surfaces exposed to view.

3.5 REMOVAL OF FORMS (ACI 301-99 Section 2)

- A. Do not remove forms, shores, and bracing until concrete has gained sufficient strength to carry its own weight, construction loads, and design loads which are liable to be imposed upon it. Verify strength of concrete by compressive test results.

3.6 PLACING REINFORCING

- A. Reinforcing shall be unpainted and uncoated, free from rust or scale and shall be cleaned and straightened before being shaped and in position.
- B. Position reinforcing accurately and tie securely.
- C. Support foot reinforcing on support chairs or concrete grout at maximum 3 feet on center each way to insure proper depth from bottom.

- D. Wire dowels to longitudinal bars and place top bars in perfect alignment by the use of wood templates placed 2 inches from the top of the form.
- E. Support wire mesh on support chairs, or other approved means, at no greater than three feet on center way to hold reinforcing in the center of the slab or as shown on the drawings.
 - 1. Do not depend on lifting mesh as concrete is being poured.
 - 2. Lap sides and ends not less than one wire spacing in slabs on grade and not less than 12 inches in structural slabs.
- F. Provide 3 inches of concrete between reinforcing and the ground, unless detailed otherwise, where concrete is poured against the ground.
- G. If, after the removal of forms, concrete surfaces are to be in contact with the ground or exposed to the weather:
 - 1. Bars larger than No.5: Protect with 2 inches of concrete.
 - 2. No. 5 bars and smaller: Protect with 1 1/2 inches of concrete.
- H. Concrete covering for any reinforcing at surfaces not exposed directly to the ground or weather: Protect with 1 -1/2 inches of concrete.

3.7 PLACING CONCRETE

- A. Convey concrete from mixer to final position by method which will prevent separation or loss of material.
- B. Maximum height of concrete free fall; 60 inches.
- C. Regulate rate of placement so concrete remains plastic and flows into position.
- D. Deposit concrete in continuous operation until panel or section is completed.
- E. Do not use concrete that has set and do not re-temper or use concrete that has been mixed for more than 1½ hours.

3.8 CONSOLIDATING CONCRETE:

- A. Use mechanical vibrating equipment for consolidation.
- B. Vertically insert and remove hand-held vibrators at points 18 inches to 30 inches apart, inserting to within 6 inches of bottom of freshly poured concrete.
- C. Do not use vibrators to transport concrete forms.
- D. Minimum vibrators frequencies: 6000 impulses per minute.
- E. Vibrate concrete minimum amount required for consolidation.

- F. Keep spare vibrator on hand during concrete placing operation.
- G. Make sure the concrete is thoroughly worked around the reinforcing, the embedded items, and into corners of forms.

3.9 SLABS (ACI 301-99 Section 5)

- A. Finish concrete slab surfaces in accordance with ACI 301-99 Section 5:
 - 1. Uniformly spread, screed, and float slabs. Do not use grate tampers or mesh rollers. Do not spread concrete by vibration.
 - 2. Light broom finish exterior surfaces, except exposed aggregate.
- B. Sidewalks: Finish sidewalks in accordance with Section 32 13 76.

3.10 CURING

- A. Cure Slabs: Use damp method as per ACI 301-99 Section 5.
- B. Cure Walls above Grade: Use moisture-retaining covering as approved by Architect/Engineer in accordance with ACI 308.

3.11 WELDING (ACI 301-99 Section 3)

- A. Welding Reinforcing Steel: Not allowed.

3.12 CONSTRUCTION JOINTS

- A. Install construction joints in accordance with ACI 301-99 Section 5
- B. Place expansion and contraction joints at 20 feet (maximum) intervals. Where possible, make joints coincide with joints in adjacent concrete.
- C. Fit joints with filler of required profiles. Recess ¼ inch below finished concrete surface.

3.13 INSERTS, EMBEDDED PARTS AND OPENINGS

- A. Provide formed openings where required for pipes, conduits, sleeves and other work to be embedded in and passing through concrete members.
- B. Coordinate work of other sections and cooperate with trade involved in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

3.14 REPAIR OF SURFACE DEFECTS (ACI 301-99 Section 5.3.7)

- A. Allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.
- B. Modify or replace concrete not conforming to required lines, detail, and elevation.
- C. Repair or replace concrete not properly placed resulting in excessive honeycombing and other defects. Do not patch, repair, or replace exposed architectural concrete except upon express direction of Architect/Engineer.

3.15 FIELD QUALITY CONTROL

- A. Four (4) concrete test cylinders will be taken by the testing laboratory for every 40 cu. yds., or fraction thereof, of concrete placed. Not less than one (1) set of test cylinders shall be taken for each day's pour.
- B. One (1) additional test cylinder will be taken during cold weather concreting and be cured on job site under same conditions as concrete it represents.
- C. One (1) slump test will be taken by the testing laboratory for each set of test cylinders taken and for each separate batch of concrete placed.
- D. Compression test cylinders: Test cylinders shall be cast on the project site by a representative of the testing laboratory.
 - 1. Make cylinders according to ASTM C31.
 - 2. Make additional sets of test cylinders for curing under job conditions:
 - a. When it is needed to determine when to remove forms.
 - b. When to put a structure into service.
 - c. When temperature extremes are expected during the curing test period.
 - 3. Make test cylinders in the presence of Architect/Engineer.
 - 4. Properly marked prepared test cylinders and fill out the card supplied by the testing laboratory with instructions on when to make test breaks and where to send the test results.
 - 5. Transport in a protected condition, each set of prepared and marked test cylinders to the designated testing laboratory for curing and testing as soon as the cylinders can be transported without damage.
- E. Compression Testing concrete Cylinders ASTM C-39: by commercial testing laboratory.
 - 1. Cure cylinders in laboratory until time for testing.
 - 2. Test each set of cylinders at 7 days and 28 days after pouring.
 - 3. Tabulation of breakage schedule and action:

Specified strength of 3,500 psi at 28 days

	Test Break	Action
7 day	Less than 2400 psi	Contractor notify A/E
	2400-3500 psi	Break 28 day cylinder
	Over 3500 psi	Stop Testing
28 day	Less than 3500 psi	Contractor notify Architect, investigate reason for low break and report in writing to AE.

4. For testing cylinders for specified compressive strength other than 3,500 psi, see the Architect/Engineer.

F. In Case of Low Compression Test Results:

1. Architect/Engineer will have right to order change in the mix design, costs to be borne by the contractor.
2. Architect/Engineer will have right to order core tests of the concrete in accordance with SCI C42, or load tests of the structure, the cost to be borne by the Contractor for either test.

3.16 PROTECTION OF COMPLETED WORK

- A. During curing period, protect the concrete from damaging mechanical disturbances, water flow, loading, shock, and vibration.

END OF SECTION

SECTION 32 12 00

FLEXIBLE PAVEMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare subgrade to receive base course.
- B. Provide compacted base course.
- C. Prime base course and place asphaltic concrete hot mix (ACHM) binder course.
- D. Tack base course and place ACHM surface course.

1.2 RELATED WORK

- A. Section 31 20 00 – Earth Moving.
- B. Section 32 16 13 – Concrete Curb and Gutter
- C. Section 33 40 00 – Storm Drainage Utilities

1.3 SUBMITTALS

- A. See Related Work

1.4 REFERENCES

- A. Arkansas State Highway and Transportation Dept (AHTD).
 - 1. Standard Specifications for Highway construction, Edition of 2003, hereafter referred to as “AHTD Standard Specifications”.

PART 2 - PRODUCTS

2.1 BASE COURSE MATERIALS

- A. Crushed Stone: Class 7, meeting the requirements of Section 303 of the AHTD Standard Specifications, or approved equal.
- B. Prime Coat: Medium curing liquid asphalt, MC-30, or approved equal, meeting the requirements of Section 401 of the AHTD Standard Specifications.
- C. Track Coat: Shall be applied as specified and meeting the requirements of Section 401 of the AHTD Standard Specifications.

2.2 ASPHALT PAVEMENT MATERIALS

A. ACHM Surface Course:

1. PG 64-22 mix as described in Sections 407 and 409 of the AHTD Standard Specifications.
2. The surface course shall be composed of a mixture of mineral aggregate and asphalt cement in the proportions by weight for the type mixture designated.

B. ACHM Binder Course:

1. PG 64-22 mix as described in Section 407 and 409 of the AHTD Standard Specifications.
2. The binder course shall be composed of mixture of mineral aggregate and asphalt cement in the proportions by weight for the type mixture designated.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. Ensure grading of the subgrade to the required elevation.
- B. Scarify to a depth of six inches the subgrade where the base course is to be placed.
- C. Water and thoroughly mix subgrade until optimum moisture content is obtained when deficiency of moisture content exists. When excess of moisture exists, rework and aerate subgrade until optimum moisture content is obtained.
- D. Re-compact the subgrade to a minimum of 95% of the maximum dry density at or near the optimum moisture content as determined by ASTM D1557.
- E. Before final rolling, shape the entire area to the required cross section, adding additional subsoil as required and compact the subgrade surface to the required density.

3.2 PLACEMENT OF BASE COURSE

- A. Place the crushed stone base material over the prepared subgrade in accordance with the construction methods described in Section 303 of the AHTD Standard Specifications.
- B. Add water during compaction to bring the base course materials to optimum moisture content. When excess moisture exists, rework the base course materials until optimum moisture content is obtained.
- C. Compact the base course to 100% of the maximum dry density as determined by ASTM D 1557.

3.3 PLACE PRIME AND TACK COAT

- A. Apply the bituminous prime coat to the compacted base at the rate of 0.3 to 0.4 gallons per square yard. Apply the bituminous tack coat to the prepared base at the rate of 0.03 gallon to 0.10 gallon per square yard as designated by the Engineer.
- B. Clean the base course surface and place the prime and tack coats in accordance with the requirements of Section 401 of the AHTD Standard Specifications.

3.4 PLACING ACHM SURFACE COURSE

- A. Construction Methods: Section 410, AHTD Standard Specifications.
- B. Temperature range mix.
 - 1. When discharged from mixer: 285 degrees F to 325 degrees F.
 - 2. When placed on base course: 275 degrees F. to 325 degrees F.
- C. Temperature of air: Do not place ACHM when air temperature in the shade is below 40 degrees F.
- D. Place asphalt pavement to compacted depth shown on Drawing.
- E. Compact to required density, with approved rolling equipment. Start compaction as soon as pavement will bear equipment without checking or undue displacement.
- F. Required density: 92% - 96% of maximum theoretical density.
- G. Carry out compaction in three operations in pass sequence. Ensure each pass of roller overlaps previous passes to ensure smooth surface free of roller marks. Keep roller wheels sufficiently moist so as not to pick up material.
- H. Perform hand tamping in areas not accessible to rolling equipment.
- I. Ensure joints made during paving operations and at connection to existing pavement are straight, clean, vertical and free of broken or loose material.
- J. Ensure surface of completed asphalt pavement is true to lines, profiles and elevations indicated, and is free from depressions exceeding 1/4 inch when measured with a 10 foot straightedge.
- K. Do not allow vehicular traffic on newly paved areas until surface has cooled to atmospheric temperature.

3.5 FIELD QUALITY CONTROL

- A. Testing laboratory will make in-place tests of density and moisture content of the subgrade and the base course in accordance with ASTM D 6938.

- B. Testing laboratory will make density tests of compacted asphalt paving in accordance with ASTM D 2950.

END OF SECTION

SECTION 32 13 13

CONCRETE PAVING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare subgrade to receive base course materials for traffic bearing drive.
- B. Place and compact base course materials for drive.
- C. Concrete drive complete with reinforcement.

1.2 RELATED WORK

- A. Section 31 20 00– Earth Moving
- B. Section 32 13 76 - Sidewalks
- C. Section 32 16 13 – Concrete Curb & Gutters

1.3 SUBMITTAL

- A. See Related Work

1.4 REFERENCES

- A. ASTM C150- Portland Cement.
- B. ASTM C94 – Ready Mixed Concrete.
- C. ASTM A185 – Welded Steel Wire Fabric for Concrete Reinforcement.
- D. ASTM A615 – Deformed and Plain Billet – Steel Bar for Concrete Reinforcement.
- E. ASTM D1751 – Preformed Expansion Joint Filler for concrete Paving and Structural construction.

1.5 INSPECTION AND TESTING

- A. Inspection and testing of concrete will be performed by a firm approved by the owner and paid for by the Contractor, in accordance with Section 01 45 29.
- B. Three (3) concrete test cylinders will be taken during cold weather concreting, and be cured on job site under same conditions as concrete it represents.
- C. One (1) slump test will be taken for each set of test cylinders taken.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Gravel Base: Angular crushed natural stone: free shale, clay and friable materials and debris.

2.2 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150; Normal –Type I. Materials for concrete paving shall conform to the requirements for Sections 32 05 23–Concrete Work.
- B. Fine and Coarse Aggregates: ASTM C33.
- C. Water Clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious material.

2.3 REINFORCEMENT

- A. Reinforcing Steel: (60) yield strength; plain and deformed billet steel bars: ASTM A615; plain finish.
- B. Welded Steel Wire Fabric: Plain type, ASTM, 6" x 6: W2.9x W2.9 size.
- C. Tire Wire: Minimum 16 gage annealed type, or patented system acceptable to Architect/Engineer.

2.4 FORMWORK AND ACCESSORIES

- A. Formwork: Matched, tight fitting and adequately stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of concrete.
- B. Joint Filler: Minimum ½-inch thick asphaltic impregnated fiberboard ASTM D751.
- C. Concrete Curing Compound: Chlorinated rubber type: clear color; ASTM C308.

2.5 CONCRETE MIX

- A. Mix and proportion to produce minimum 4000 psi concrete at 28 days with maximum slump of 3 inches and 4 to 6 percent air entrainment.
- B. Use accelerating admixtures in cold weather only when acceptable to Architect/Engineer. Use of admixtures shall not relax cold weather placement requirements. Do not use calcium chloride.
- C. Use set-retarding admixtures during hot weather only when acceptable to Architect/Engineer.

PART 3 - EXECUTION

3.1 PREPARATION OF SUBGRADE

- A. Ensure rough grading has brought subgrade to required elevations.
- B. Fill soft spots and hollows with additional fill.

3.2 PLACEMENT OF GRAVEL FILL AND SAND CUSHION

- A. Place and level gravel fill over prepared subgrade to a compacted depth indicated on drawings true to lines and levels.
- B. During concrete placement, keep base sufficiently moist to prevent excessive absorption of water from freshly placed concrete.

3.3 FORMING

- A. Form vertical surfaces to full depth and securely position to required lines and levels. Ensure form ties are not placed so as to pass through concrete.
- B. Arrange and assemble formwork to permit easy dismantling and stripping, and to prevent damage to concrete during formwork removal.

3.4 PLACING REINFORCEMENT

- A. Reinforce concrete drives: Allow for minimum 1 -1/2 inch concrete cover.
- B. Do not extend reinforcing through expansion and contraction joints. Provide dowelled joints through expansion and contraction joints, with one end of dowels fitted with capping sleeve to allow free movement.

3.5 FORMING EXPANSION AND CONTRACTION JOINTS

- A. Place expansion and contraction joints at 20 feet (maximum) intervals. Where possible, make joints of curbs coincide with joints in drive.
- B. Fit joints with filler of required profiles, set drives perpendicular to longitudinal axis of drives. Recess ¼ inch below finished concrete surface.

3.6 PLACING CONCRETE

- A. Place concrete, screed and wood float surfaces to a smooth and uniform finish, free of open texturing and exposed aggregate.
- B. Avoid working mortar to surface.

- C. Make 1/4-inch wide dummy joints as indicated on Drawings.
 - D. Round all edges, including edges of dummy and expansion and contraction joints, with 1/4-inch radius edging tool.
 - E. Where paved surfaces are adjacent to walks, make concrete curbs and gutters integral with walks. Make expansion and contraction joints of curbs coincide with walk joints. Provide dummy joint at line between walks and curbs.
 - F. Provide exposed surfaces of drives with broom finish.
 - G. Ensure finished surfaces do not vary from true lines, levels or grade by more than 1/8 inch in 10 feet when measured with straightedge.
 - H. Apply curing compound on finished surfaces immediately after placement. Apply in accordance with manufacturer's recommendations.
- 3.7 WASTE MANAGEMENT: Divert waste from the landfill in compliance with Construction Waste Management and Disposal.

END OF SECTION

SECTION 32 13 73

CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Cold-applied joint sealants.
 - 2. Hot-applied joint sealants.

- B. Related Work:

- 1. Section 32 13 13 - Concrete Paving

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufactures, for testing indicated below, Samples of material that will contact of affect joint sealants.

- 1. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Submit no fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
 - 5. Testing will no be required if joint-sealant manufactures submit joint-preparation data that are based on previous testing, not older than 24 months, of sealant products for compatibility with and adhesion to joint substrates and other materials matching those submitted.

1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.

- B. Samples for Verification: For each kind and color of joint sealant required, provide samples with joint sealants in ½ inch wide joints formed between two 6-inch long strips of materials matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Pavement-Joint Sealants Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.
- D. Qualification Data: For qualified Installer.
- E. Product Certificates: For each type of joint sealant and accessory, from manufacturer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for joint sealants.
- G. Preconstruction Compatibility and Adhesion Test Reports: From joint-sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility with and adhesion to joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this project.
- B. Source Limitations: Obtain each type of joint sealant from single source from single manufacturer.
- C. Product Testing: Testing joint sealants using a qualified agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.

2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joints Sealants: As selected by Architect/Engineer from manufacturer's full range.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work, include, but are not limited to, the following:
 - a. Crafco Inc., and ERGON company; RoadSaver Silicone.
 - b. Dow Corning Corporation; 888.
 - c. Pecora Corporation; 301 NS.
- B. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work, include, but are not limited to, the following:
 - a. Crafco Inc., and ERGON company; RoadSaver Silicone SL.
 - b. Dow Corning Corporation; 890-SL
 - c. Pecora Corporation; 300 SL
- C. Multicomponent, Pourable, Traffic-Grade, Ethane Joint Sealant for Concrete: ASTM C 920, Type M. Grade P, Class 25, for Use T.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corporation; Urespan NR-200.

2.3 HOT-APPLIED JOINT SEALANTS

- A. Hot-Applied, Single-Component Joint Sealant for Concrete: ASTM D 3406.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crafcro Inc., an ERGON company; Superseal444/777.
- B. Hot-Applied, Single-Component Joint Sealant for Concrete and Asphalt: ASTM D 6690, Types I, II, and III.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Meadows, W.R., Inc. Sealtight 3405.
 - b. Right Pointe; D-3405 Hot Applied Sealant.

2.4 JOINT– SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer roads for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Round Backer Roads for Cold-Applied Joint Sealant.
- D. Backer Strips for Cold and Hot –Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.5 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install joint-sealant backings of kind indicated to support joint sealant during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of joint-sealant backings.
 - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
 - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place joint sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nosag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated: to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
 - 1. Remove excess joint sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING

- A. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joints sealant so installations in repaired areas are indistinguishable from the original work.

END OF SECTION

SECTION 32 13 76

SIDEWALKS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Providing concrete sidewalk where shown on Drawings.
- B. Providing concrete handicap ramps where shown on Drawings.

1.2 RELATED WORK

- A. Section 31 20 00 – Earth Moving.
- B. Section 32 05 23 – Cement and Concrete for Exterior Improvements.
- C. Section 33 05 16 – Manholes and Structures.

1.3 SUBMITTALS

- A. See Related Work

1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM D 1751, Specifications for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

PART 2 - PRODUCTS

2.1 CONCRETE

- A. General: Materials for use in sidewalk construction shall conform to the requirements for Section 32 05 23, and shall be 3500 psi concrete.

2.2 WORK INCLUDED

- A. The joint filler for all expansion joints shall be manufactured according to ASTM D 1751 and shall be elastic waterproof pre-molded compound that will not become soft and push out in hot weather, nor hard and brittle and chip out in cold weather. The strips shall be ½" in thickness except where shown otherwise on the Drawings; their width shall at least equal the full thickness of the slab; and their length shall at least equal the width of the slab at the joint.

2.3 FORMS

- A. Forms shall be steel or 2" nominal thickness lumber true to proper dimensions, smooth, sufficiently braced to resist springing out of shape, and accurately set to proper lines and grades. Used forms shall be free of dirt and mortar. Cross forms shall be ¼" steel of the full width and depth of the concrete work and left in place until the wearing surface has been floated and has obtained its initial set.

2.4 CURING COMPOUND

- A. Liquid membrane forming curing compound conforming to AASHTO M 148, Type 2, white pigmented (all-resin base).

PART 3 - EXECUTION

3.1 GRADING AND SUBGRADING

- A. Prepare subgrade for walks by excavating or filling to a depth below the top of an intended pavement equal to the thickness of the finished walk and in exact conformity to the grade approved by the Engineer. Remove vegetative matter or material that will not compact properly and replace with suitable material. Place all fill required to bring the subgrade to the proper level in thin layers not exceeding 4 inches deep, and thoroughly ram, tamp or roll until it has been made compact and solid. Bring subgrade to true grade in a uniformly firm condition before placing the concrete. Do not place concrete on the subgrade until the Engineer has inspected and approved both grade and condition of subgrade.

3.2 SETTING FORMS

- A. Stake forms and hold to the established lines and grades. Provide minimum 1/8" per foot fall away from structures or as shown on the drawings.

3.3 TREATMENT

- A. Wet wood and coat metal forms with oil, soft soap, or whitewash before depositing any material against them. Remove all mortar and dirt from forms that have been previously used.

3.4 MARKINGS

- A. Cut surface of concrete walks into flags by marking with an edging tool having a radius of ¼". Make flags not longer than 6 feet on any side nor longer than the width of the sidewalk. Round the slabs on all surface edges, including the cross markings between flags, to a radius of ¼".
- B. Score surface or ramp as shown on Standard Detail Drawings.

3.5 JOINTS

- A. Provide an expansion joint ½" in thickness, extending full depth of the concrete and with filler as herein specified, at intervals of not more than 15 feet. Provide a similar joint ½" in thickness in each walkway at intersection of walkways. Also provide an expansion joint ½" in thickness at each intersection of sidewalk and street curb and at such other points as may be designated by the Engineer. Separate sidewalk from abutting structures by ½" expansion joints. Place expansion joints ½" in thickness extending full depth of the concrete in a square outline around each object in sidewalks, such as fire hydrants, utility poles light standards, etc.

3.6 PLACING CONCRETE

- A. Place concrete only on a moist subgrade and not adjacent to or around utility structures until such structures have been set to the proper grade.
- B. Transport from the mixer and place by such a means as will not cause segregation of materials or loss of ingredients. Deposit successive batches in one layer by a continuous operation, completing individual sections to the required depth and width. Do not use concrete that has taken its initial set. Fill forms and bring the concrete to the established grade by means of a strike board or straight edge. Thoroughly tamp concrete until mortar is flushed to the surface sufficiently to finish and mark the surface.
- C. Spade and/or vibrate the concrete so that it will flow together and completely fill all void spaces especially along forms (including cross forms of joints) to prevent honeycombing and shall be struck off and tamped in an approved manner, until dense surface is obtained, free from porous or rough spots and at the required sections and grade.
- D. Use method of placing the various sections so as to produce a straight clean-out joint between them, in order to make each section an independent unit. Do not use any concrete in excess of that needed to complete a section at the stopping of work.
- E. Do not pour concrete when temperature is below 35 degrees Fahrenheit, and do not place concrete on frozen subgrade. Take all necessary precautions to prevent damage to concrete in excess of that needed to complete a section at the stopping of work.
- F. At all times during construction period, maintain proper drainage, by natural flow or pumping as required, so that water will drain away from excavated areas. Do not allow water to stand in any excavations, or elsewhere, to be covered by concrete. Provide and maintain in proper working order all necessary pumping and other equipment required to maintain drainage.

3.7 FINISH

- A. After the concrete has been brought to the established grade by means of a strike board and tamped to bring the mortar to surface, float to a true even surface and finish with steel trowel. After the trowel finish has taken its initial set, brush surface lightly at right angles to center line of sidewalk with a soft bristle brush.
- B. Do not apply heat to the concrete surface to hasten its hardening.

3.8 CURING AND PROTECTION:

- A. As soon as the concrete has hardened sufficiently to prevent damage, apply specified liquid membrane-forming curing compound in accordance with manufacturer's written instructions.
- B. Protect the freshly finished concrete from hot sun and drying winds until the curing compound is applied. Do not allow the concrete surface to be damaged or pitted by raindrops. Provide and use, when necessary, sufficient tarpaulins to completely cover all sections that have been placed within the proceeding twelve hours. Erect and maintain suitable barriers to protect the concrete. Repair any section damaged from traffic or other causes occurring prior to its official acceptance. Before the sidewalk is opened to traffic, remove and dispose of the covering.

3.9 FREEZING TEMPERATURE

- A. If at any time during the progress of the work, the temperature is predicted to drop below 35 degrees Fahrenheit within 24 hours after placement, heat the water and aggregates and take precautions to protect the work from freezing for at least five days.

END OF SECTION

SECTION 32 16 13

CONCRETE CURB AND GUTTER

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Construct cast-in-place combination curb and gutter.

1.2 RELATED WORK

- A. Section 31 20 00 – Earth Moving.
- B. Section 32 13 76 - Sidewalks
- C. Section 32 05 23 – Cement & Concrete for exterior improvements.

1.3 SUBMITTALS

- A. See Related Work

1.4 QUALITY ASSURANCE

- A. Perform cast-in-place concrete in accordance with ACI 301 and Section 32 05 23.
 - 1. Standard Specifications for Highway construction, Edition of 2003, hereafter referred to as “AHTD Standard Specifications”.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Ready Mixed concrete: ASTM C94 and Articles 2.01 through 2.06 of Section 32 05 23.
- B. Curing Compound: ASTM C309.
- C. Pre-formed expansion joint fillers: ASTM D1751-78.
 - 1. Thickness: ½ inch.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. Grade subgrade and compact in same manner and to same density as specified in Section 31 20 00 controlled fill.

3.2 INSTALLATION

- A. Cast-in-place Concrete: Refer to Section 32 05 23

1. See standard Detail Drawings for Curb and Gutter, and for Handicap Ramp.
 2. Prepare subgrade in accordance with Section 31 20 00.
 3. Set forms to line and grade.
 4. Install forms over full length of curb.
 5. Form contraction joints at maximum 10 feet spacing using steel templates, division plates or sawcuts.
 6. Remove templates or plates as soon as concrete has hardened sufficiently to retain its shape.
 7. Install preformed expansion joint fillers at maximum 60 feet spacing, at curb returns, and behind curb at abutment to sidewalks and other structures.
 8. Place top of expansion joint material $\frac{1}{4}$ inch below curb surface.
 9. Place concrete in position without separation of concrete materials.
 10. Consolidate concrete with mechanical vibrators.
 11. Round face of curbs at top with finishing tool of correct radius.
 12. Finish exposed surfaces with wood float followed by light brushing with broom.
 13. Apply curing material and cure for seven days.
- B. Repair of surface defects: Comply with requirements of Section 32 05 23.
- C. Field Quality Control: Comply with requirements of Section 32 05 23.
- D. Protection of Completed Work: Comply with requirements of Section 32 05 23.

END OF SECTION

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Providing pavement markings as shown on Drawings.

1.2 REFERENCE STANDARDS

- A. Federal Specifications (FS):
 - 1. TT-P-115E Paint, Traffic, Highway, White and Yellow.
 - 2. TT-P-1952B Paint, Traffic, and Airfield Marking, Water Emulsion Base.
- B. Federal Standard (Fed. Std.)
 - 1. No 141B Paint, Varnish, Lacquer, and related materials.
- C. Arkansas State Highway and Transportation Department (AHTD)
 - 1. Standard Specifications for Highway Construction, 2003 Edition

1.3 SUBMITTALS

- A. Submit a test report showing either that the proposed batch meets all specified requirements or that a previous batch manufactured using the same formulation as that used in manufacturing the proposed batch for the following properties required in the material specification: weight per gallon, viscosity, fineness of grind, drying time, and gradation. Testing procedures and reports shall be as specified in paragraph 5 of Method 1031.2 of Fed. Std.141.

1.4 DELIVERY, HANDLING AND STORAGE

- A. Deliver material in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, formulation number and directions, all of which shall be plainly labeled at time of use.
- B. Furnish paint in containers not larger than five gallons.
- C. Store paint on project site. Store emulsion paints to prevent freezing.

1.5 SITE CONDITIONS

- A. Unless other wise recommended by the paint manufacturer apply pavement markings material only when the ambient temperature is between 40 and 95 degrees F.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Parking:

1. Manufactured according to FS TT-P-115E, FS TT-P-1952B or AHTD Standards Specification Section 718,719, or 720.
2. Color: White.
3. Handicapped Access Aisles on Asphalt Paving: Color, White
4. Handicapped Access Aisles on Concrete Paving: Color, ADA Blue
5. Paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of six months.
6. Note: Verify colors with owner prior to painting.

B. Roadway:

1. Manufactured according to AHTD Standard Specifications Section 719 or 720.
2. Color:
 - a. Separating traffic traveling in opposite directions: Yellow
 - b. Left edge of roadways: Yellow
 - c. Separating two-way left turn lanes and reversible lanes from other lanes: Yellow
 - d. All other applications: White
 - e. Pre-molded striping and symbols as shown and called for on plans.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Allow new pavement surfaces to cure for a period of not less than 30 days before application of markings materials.
- B. Thoroughly clean all surfaces to be marked before application of paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required.
- C. Completely remove rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed.
- D. Where oil or grease are present on old pavements to be marked, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse

thoroughly after each application. After cleaning, seal, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.

3.2 EQUIPMENT

- A. General: Use only approved machines, tools, and equipment. Maintain equipment in satisfactory operating condition. Hand-operated push type machines of a type commonly used for application of paint to pavement surfaces will be acceptable for marking small street and parking areas. Use applicator machine equipped with the necessary paint tanks and spraying nozzles. Equipment shall be capable of applying paint uniformly at coverage specified. Provide sandblasting equipment as required for cleaning surfaces to be painted. Use hand-operated spray guns for use in areas where push-type machines cannot be used.
- B. Sandblasting Equipment: Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 150 c.f.m of air at a pressure of not less than 90 psi at the nozzle for each nozzle used.
- C. During concrete placement, keep base sufficiently moist to prevent excessive absorption of water from freshly placed concrete.

3.3 APPLICATION

- A. Rate of Application: Apply two (2) coats of paint at manufacturer's recommended rate with total maximum of 320 lineal feet per gallon per coat with 4" wide stripe. Apply with mechanical equipment to produce uniform straight edges. At sidewalk curbs, use a straightedge to ensure a uniform, clean, and straight stripe.
- B. Paint: Apply paint in stripes of specified width to clean, dry surfaces, unless otherwise approved, only when air and pavement temperature is above 40 F and less than 95 F. Maintain paint temperature within these limits. Apply paint pneumatically with approved equipment at rate of coverage specified herein. Provide guide lines and templates as necessary to control paint application. Take special precautions in marking numbers, letters, and symbols. Sharply outline all edges of markings. Maintain the maximum drying time requirements of the paint specifications to prevent undue softening of bitument, and pickup, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the markings, discontinue painting operations until cause of the slow drying is determined and corrected.

3.4 PROTECTION

- A. Prevent damage to newly painted surfaces by either placing small markers along newly painted lines or controlling traffic to keep vehicles away from area of newly painted lines.

END OF SECTION

SECTION 32 84 11

LANDSCAPE IRRIGATION SYSTEM PERFORMANCE SPECIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and fittings, valves, outlets, backflow preventer, and accessories.
- B. Connection to utilities and meter installation.
- C. Automatic control system.

1.2 RELATED WORK

- A. Section 31 20 00- Earth Moving.
- B. Section 32 92 23 - Sodding.
- C. Section 32 93 00 - Plants.

1.3 REFERENCES

- A. ASTM D 1785 - Poly Vinyl Chloride (PVC) Plastic Pipe (SDR-PR).
- B. ANSI/ASTM D 2564 - Solvent Cement for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings.
- C. City of Central Arkansas Water Standard Specifications.
- D. Rain Bird Irrigation Installation Details and Specifications

1.4 DESIGN AND SYSTEM DESCRIPTION

- A. Contractor's design for automatic, electric valve, irrigation system with 100 percent coverage and minimal over spray onto buildings and paved surfaces to meet the following design standards:
 - 1. Irrigation water meter to be provided by General Contractor.
 - 2. Provide backflow preventer assembly with heated and insulated housing and hardwired connections to power source.

3. Provide automatic controller, control cable, and hardwired connections to power source.
4. Provide separate valve zones for turf and planted bed areas.
5. Provide pop-up spray and/or rotor type outlets for turf areas.
6. Space outlets to provide near 100% overlapped coverage between each outlet.
7. Provide drip irrigation for planted bed areas.
8. Provide drip emitters for trees in drip zone areas.
9. Specify sizing for all piping, and equipment items.
10. Locate controller and backflow preventer as shown in the Landscape Plan.
11. Piping to be located along back of curbs, pavement edges, and bed edges.
12. Spray from perimeter of areas where feasible.
13. Provide 100% coverage of all newly planted landscape areas and/or other areas as indicated in the Landscape Plan.
14. Provide manual drain valves and sumps, or piped connections to drainage system.
15. Provide rain sensor shut-off device.
16. Provide valve boxes and covers where required.
17. Minimize the number of outlets, trenching, and pipe installation where possible.

1.5 SUBMITTALS

- A.** Shop Drawing Required: Proposed to meet design standards as outlined in 1.4, A, "Design and System Description." Illustrate system over base of site information including site structures, plant and landscaping features (screened print or AutoCAD drawing provided on request). Provide complete schedule of equipment, outlets, valves, etc. to be used. Provide typical details for installation of outlets, valves and backflow preventer. The following design information is required to be shown: sizes of all lines and equipment, estimated GPM flows for each zone, locations of drain valves and sumps, locations of surge protectors, zone numbers, and programming of multiple zone operations.
- B.** Product Information: Provide product specification sheets that clearly identify each system component proposed for use. Indicate specific components when more than one item is covered on spec sheets.

1.6 PROJECT RECORD DOCUMENTS

- A.** Prepare record drawing of irrigation system with accurate locations of sleeving, piping, and all system components. The following information is also required to be shown: sizes of all lines and equipment, estimated GPM flows for each zone, locations of drain valves and sumps, locations of surge protectors, zone numbers, and programming of multiple zone operations.
- B.** OPERATION AND MAINTENANCE DATA
- C.** Furnish to Owner instructions for operation and maintenance of system and controls, seasonal activation and shutdown, and manufacturer's parts catalog.
- D.** Program controller and furnish to Owner a recommended schedule indicating length of time each valve zone is to be open to provide appropriate amount of water for normal seasonal watering schedules.

1.7 REGULATORY REQUIREMENTS

- A.** Conform to applicable state and local plumbing codes for piping and component requirements.
- B.** Acquire certificate of compliance from local authority indicating approval of backflow preventer installation.

1.8 FIELD MEASUREMENTS

- A.** Verify that field conditions are as shown in the drawings. Revise design and record drawing as required.

1.9 EXTRA MATERIALS

- A.** Furnish to Owner the following extra components:
 - 1. Two sprinkler heads of each type and size.
 - 2. Two nozzle inserts for each type and size.
 - 3. Two drip emitters of each type and size
 - 4. Two drip line basket filters of each type and size.
 - 5. Two keys each for valve boxes and controller (if locked boxes are used).
 - 6. Two of any required special tools for adjustment or replacement of each type of outlet, nozzle, valve, and other system equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Rain Bird Corporation, Turf Division: For irrigation system equipment.
- B. Wilkins/Zurn: For backflow preventers

2.2 MATERIALS

- A. Pipe: PVC in accordance with ASTM D 1785: PVC Schedule 40 pipe for all main lines, lateral lines, and fittings throughout system. Solvent-weld sockets. Rigid copper pipe required from tap at public main through back flow preventer.
- B. Fittings: Type and style of connection to match pipe.
- C. Solvent Cement: ANSI/ASTM D 2564 for PVC pipe and fittings.
- D. Tracer Wire: 12 AWG solid copper wire with white insulating cover, to be tagged as “Tracer wire” with metal tags.

2.3 OUTLETS

- A. Spray Outlets: Rain Bird 1800 Series 1806/1812-SAM-PRS pop-up spray bodies with U-Series nozzles where possible. Use MPR or VAN nozzles where necessary to fit coverage areas.
- B. Rotary Nozzle Outlets: Rain Bird 1800 Series 1806/1812-SAM-PRS pop-up spray bodies with Rain Bird Rotary Nozzles, sized to fit coverage areas.
- C. Stream Rotor Outlets:
 - 1. Rain Bird 5000 Plus Series: 5004/5006/5012-SAM-R Plus pop-up rotor bodies with MPR nozzles, outlet nozzles and radius matched for placement and coverage conditions.
 - 2. Rain Bird 5500 Series: 5005/5512 pop-up rotor bodies with nozzles, outlet nozzles and radii matched for placement coverage conditions and precipitation rates.
 - 3. Rain Bird 6504 Series: F4-FC/PC pop-up rotor bodies, outlet nozzles and radius matched for placement and coverage conditions.
- D. Drip System Outlets:
 - 1. Rain Bird XF Series Dripline: XFD-09-12 Dripline and fittings spaced along shrub lines or 24 inches on center in ground cover areas. Assemble drip lines with Rain Bird Easy Fit Compression Fittings.

2. Rain Bird Pressure-Compensating Modules: PC-12/18/24 drip emitters for tree placements within drip zones; one drip emitter for each ornamental size tree and two drip emitters for each medium or large size tree. Provide PC Diffuser Caps for each emitter.

2.4 VALVES AND OTHER EQUIPMENT

- A. Control Valves: Rain Bird PEB Series: 100/150/200-PEB electric valves. Size for minimum pressure loss for designed flow rate. *Provide and install PRS-Dial pressure regulating devices for each valve placement.*
- B. Backflow Preventer: Wilkins/Zurn: 975XL or 975XLSEU backflow preventer sized for maximum flow in system with a maximum pressure loss limited to 10% of available residual pressure.
- C. Backflow Preventer Housing: DeKorra model 301/301, Class I (heated), green/tan color, anchored to 4" minimum concrete base per manufacturers details and specifications. Provide hardwired power connection with receptacle in enclosure and conduit for heating element.
- D. Swing Joints: Rain Bird TSJ-12075 swing joints required for all 5000 Plus rotor placements.
- E. Pressure Regulating Swing Joints: Rain Bird TSJ-100-PRS swing joints required for all rotor placements that do not have internal pressure regulation.
- F. Valve Boxes and Covers: Rain Bird VB-7RND/10RND valve boxes with black covers required for all control valves, drip filters, drain valves, surge protectors, and wiring junctions.
- G. Drip Line Filters: Rain Bird Quick-Check Basket Filters: QKCHK-75/100 filters, sized to match zone flows, installed with valve in valve box.
- H. Drain Valves: Manual, PVC valves on tees for low points in system.

2.5 CONTROLS

- A. Controller: Rain Bird ESP-LXD sized for required number of stations with grounding per manufacturer specifications and hardwired connections to power source.
- B. Controller Housing: Steel, weatherproof, with lockable access door for exterior installations. Plastic housing for interior installations.
- C. Accessories: include required fittings, galvanized metal electrical conduit, and accessories for installation.
- D. Control Cable: Rain Bird Maxi-Cable 2 x 14 gauge with direct burial waterproof connectors.
- E. Field Decoders: Rain Bird FD-101TURF Two-Wire Decoders, one per zone valve.
- F. Surge Protectors: Rain Bird LSP-1TURF Line Surge Protectors, one per 400 linear feet along length of control cable and at cable end point. Provide grounding rods or plates at each placement per manufacturer specification.

- G.** Rain Sensor: Rain Bird WR2-RC wireless automatic, adjustable, shutoff device to disable/delay operations during or after recent rainfall.

PART 3 - EXECUTION

3.1 EXAMINATION

- A.** Verify that field conditions are acceptable and are ready to receive work.
- B.** Verify location of existing utilities. Repair utilities damaged as a result of this work at no increase in Contract Sum.
- C.** Verify that required utilities are available in proper location and ready for use.
- D.** Verify water pressure at backflow preventer.
- E.** Verify sleeve locations.
- F.** Beginning of installation means installer accepts existing conditions.

3.2 PREPARATION

- A.** Layout and stake locations of system components.
- B.** Review layout requirements with other affected work. Coordinate locations of sleeves under paving to accommodate system. Notify Architect/Engineer for approval of field changes to system design.
- C.** Coordinate location of controller, rain sensor device, and connections to power source with Owner, General Contractor, and Electrical Contractor.

3.3 TRENCHING

- A.** Minimum Trench Depth: Trench depth must provide a minimum of 18 inches of cover over all main lines and wiring and 12 inches of cover over all lateral lines.
- B.** Trench to accommodate grade changes and slope to manual drain valves at low points in system.
- C.** Maintain trenches free of rocks, obstructions, or other debris that may damage pipe or wiring.
- D.** Repair or replace existing improvements damaged by work performed under this contract with equivalent materials or products.

3.4 INSTALLATION

- A.** Install pipe, backflow preventer, valves, valve boxes, wiring, controls, and outlets in accordance with manufacturer's details, instructions and minimum standards.
- B.** Install drip lines, filters, fittings, etc. in accordance with manufacturer's details, instructions and minimum standards and secure with staking as specified in the drawings
- C.** Install manual drain valves at system piping low points and pipe connections from valves to site drainage system, or, provide 12" diameter by 24" deep, gravel filled drain sumps where piped connections are not feasible.
- D.** Connect to water and electrical services.
- E.** Set outlets and box covers at finish grade elevations.
- F.** Install cast concrete thrust blocking at all piping bends for 3 inch or larger pipe sizes.
- G.** Use flex pipe to connect spray outlets, use threaded connections to lateral lines for fixed risers and swing joints.
- H.** Install control cable along main lines to valves and provide 30-inch expansion coil at each valve and change of direction. Also provide 30-inch expansion coils at 100-foot intervals between valves.
- I.** Tracer Wire: Install tracer wire from gate valve at backflow preventer along all main lines to each zone valve. Terminate at valve boxes with 24" wire coil and metal tags labeled as "Tracer Wire."
- J.** Install automatic controller. Provide hardwired connection to power source, enclose wiring to system and power source in rigid metal conduit where exposed. Paint exposed conduit to match building exterior.
- K.** Install rain sensor device and connection to controller.
- L.** After piping is installed but before sprinkler heads are installed and trenches backfilled, open valves and flush system with full head of water.
- M.** Repair or replace any other work or improvements damaged as a result of work related to system installation at no increase to the Contract Sum.

3.5 FIELD QUALITY CONTROL

- A.** Prior to backfilling and installation of outlets, cap or plug pipes and test system for leakage. Maintain maximum available pressure for one hour. Piping is acceptable if no leakage or loss of pressure occurs during test period.

3.6 BACKFILLING

- A.** Backfill and compact all pipe trenches to prevent settlement and match finish grade elevations.

3.7 ADJUSTING

- A.** Adjust control system to achieve time cycles required for adequate watering at time of installation.
- B.** Adjust heads and/or nozzles to achieve proper coverage and performance. Make nozzle or head changes as necessary for proper coverage.
- C.** Adjust zone valves for proper operating pressures at valve zones.

3.8 DEMONSTRATION & CLOSEOUT

- A.** Provide system demonstration to Owner and Architect/Engineer for review and final acceptance of work.
- B.** Instruct Owner or representative in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance material as basis for demonstration.
- C.** Deliver record drawing of system, required operation and maintenance information, extra materials and backflow preventer certificate to Owner at the instruction meeting.

3.9 INSTALLER'S FIELD SERVICES

- A.** Provide one complete spring startup and fall shutdown service. Coordinate demonstration of procedures with Owner. Review system operation and components during service visit.

3.10 WARRANTY

- A.** Provide one-year materials and workmanship warranty on all system components and installation beginning on date of acceptance of the work.
- B.** Replace failed components immediately upon notification by Owner or Architect/Engineer.

END OF SECTION

SECTION 32 91 13

SOIL PREPARATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Related Documents: The Drawings, Division 1 sections and the owner's contract requirements apply to the work under this section.
- B. Work Included:
 - 1. Provide planting media amendment.
 - 2. Provide testing and/or certification of soils.
 - 3. Amending of existing soil for planting.
 - 4. Mixing of planting mediums
 - 5. Transporting and storage of soils and planting mediums.
 - 6. Machinery and loading restrictions.

1.2 RELATED WORK

- A. Section 31 22 16 – Fine Grading
- B. Section 32 84 10 – Landscape Irrigation System
- C. Section 32 93 00 - Plants

1.3 QUALITY ASSURANCE

- A. Certificates of inspection: Provide those required by law for transportation, with invoice. File copies of certificates with Landscape Architect after acceptance of material. Inspection by governmental officials at point of origin does not preclude rejection of materials at project site.
- B. Intent: The amendments and quantities included herein are approximate and for bidding purposes only. Following an on-site soil analysis by the Wallace Labs, El Segundo, California, 310-615-0116, composition of amendments may change. Contract price shall be adjusted accordingly.

1.4 BIDDING

- A. The amendments, quantities and procedures included herein are for bidding purposes only. Following an on-site agricultural soil analysis after the rough grading, the amendments and quantities and procedures may change.

- B. Tests shall be paid for by the Contractor.
- C. Product Data: Submit manufacturer's product data.

1.5 JOB CONDITIONS

- A. Protection of Existing Plants to Remain: Refer to Sections 32 93 00 & 32 01 90.

1.6 SUBMITTALS

- A. Samples and Product Data: Provide literature and samples for review and approval prior to delivery to the site.
 - 1. Organic Amendments: 1-pint sample.
 - 2. Chemical Additives: Literature.
 - 3. Soil analysis and recommendations.
- B. Test Data: Submit all laboratory test data for all materials.
- C. Submittal Schedule: All products in this section which are required for submittal shall be included in one (1) Division 2 submittal package.
- D. Protect units from damage during delivery and store under tarp when time from delivery to installation exceeds one week. Keep Hydogrow in a dark and dry location.
- E. Storage: Store materials in accordance with manufacturer's instructions.
- F. Handling: Protect materials during handling and installation to prevent damage.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Labeling: Furnish standard products in unopened manufacturer's standard containers bearing original labels showing quantity, analysis and name of manufacturer.
- B. Storage: Store products with protection from weather or other conditions which would damage or impair the effectiveness of the product.

1.8 ANALYSIS OF SAMPLES AND TESTS

- A. Sampling: Landscape Architect reserves the right to take and analyze samples of materials for conformity to specifications at any time. Furnish samples upon request by Landscape Architect.
- B. Rejected Materials: Remove rejected materials immediately from the site at Contractors expense.

- C. Compatibility Test: Prior to review of the on-structure planting media, submit required quantity of Contractor selected media with filter for compatibility test by Owner's Testing Agency. Repeat test as necessary at Contractors cost.
- D. Testing: Pay cost of testing of materials not meeting specifications.
- E. Testing Agency: Wallace Laboratories, 365 Coral circle, EL Segundo, CA 80245. Tel 310-615-0116, Attn: Mr. Garn Wallace, Ph D.

1.9 FINAL ACCEPTANCE

- A. Acceptance: The Landscape Architect will accept the work upon satisfactory completion of all soil preparation.
- B. Notification: Notify Landscape Architect for review of soil preparation prior to proceeding with planting operations.

PART 2 - PRODUCTS

2.1 TOPSOIL

- A. Definition: Topsoil shall be defined as soil material that could be used in the planting mixes for backfill of tree, shrub, and groundcover planting pits, provided it can be made to conform to the provisions included under the title "Topsoil".
- B. General Qualifications: Topsoil shall be fertile, friable, well-drained soil, of uniform quality, free of stones over 1inch diameter, sticks, oils, chemicals, plaster, toxic substances, concrete and other deleterious materials, as planting medium for the project.
 - 1. Grading:

a. Sieve size	Percent Passing Sieve
1) 25.4 mm (1")	95-100
2) 9.51 mm (3/8")	85-100
3) 53 micron (270 mesh)	10-30
 - 2. Chemistry –Suitability Considerations:
 - a. Salinity: Saturation Extract Conductivity (ECe X10³ @ 25 degrees C.) less than 4.0 sodium: Sodium Absorption Ration (SAR) less than 9.0.
 - b. Boron: Saturation Extract Concentration less than 1 mg/l (parts per million).
 - c. Reaction: PH of Saturated Paste: 5.5 -7.5.
- C. Existing Soil to be Amended: Inspect existing soil and do all work necessary to bring it to standards specified under "General Qualification" above. Amend as specified herein.
 - 1. This contractor shall schedule a site visit with the Landscape Architect for the purpose of obtaining a soil analysis. Samples shall be taken from three typical tree locations and delivered by the Contractor to the designated soil-testing laboratory. Submit soils analysis and recommendations to the Landscape Architect for acceptance. Soil analysis shall indicate quantities, chemical properties and recommended manufacturer or supplier.

2. Areas of existing soil to be amended shall be all areas to be planted. Modified amending without tilling is required in slope areas. Turf and grass shall receive full soil preparation.

2.2 ORGANIC AMENDMENTS

- A. Compost Amendment: Acceptable products are finely ground tree and shrub trimmings and vegetable products that have been decomposed and fully composted at least 120 days. The product shall be based upon compost. Wood residues, sawdust or shavings that have been fully composted are not acceptable. The ash content shall be at least 15% and not more than 25%. Sand content shall be less than 2%. The PH shall not be less than 5.0 or more than 7.5 the ECe shall be less than 8.0.

2.3 CHEMICAL ADDITIVES:

- A. The following additives may or may not be used depending on the outcome of the soils report.
 1. Ground Limestone: Agricultural limestone containing not less than 85% of total carbonates, ground to such fineness that 50% will pass #100 sieve and 90% will pass #20 sieve.
 2. Dolomite Lime: Agricultural grade mineral soil conditional containing 35% minimum magnesium carbonate and 49% minimum calcium carbonate, 100% passing #65 sieve. "Kaiser Dolomite 65AG" as manufactured by Kaiser, Inc. Mineral Products Department, or equal.
 3. Gypsum: Agricultural grade product containing 80% minimum calcium sulphate.
 4. Iron Sulfate (Ferric or Ferrous): Supplied by a commercial fertilizer supplier, containing 20% to 30% iron and 35% to 40% sulphur.
 5. Soil Sulphur: "Sul-Fe/Sulfur" as supplied by Red Star Fertilizer of Corona, CA 91720. Tel (714) 597-4801.
 6. Sulphate of Potash: Agricultural grade containing 50% to 53% of water –soluble potash.
 7. Single Superphosphate: commercial product containing 20% to 25% available phosphoric acid.
 8. Ammonium Sulphate: Commercial product containing approximately 21% ammonia.
 9. Ammonium Phosphate: Commercial product containing approximately 18% ammonia.
 10. Ammonium Nitrate: Commercial product containing approximately 34% ammonia.
 11. Calcium Nitrate: Agricultural grade containing 15-1/2 % nitrogen.
 12. Urea Formaldehyde (N-Hro-Form): Granular commercial product containing 38% nitrogen.

13. I.B.D.U. (Iso Butyldience Diurea). Commercial product containing 31% nitrogen.
14. Soil Sulfur: Agricultural grade sulfur containing a minimum of 96% sulfur.
15. Iron Sequestrene: Geigy Iron Sequestrene 330 Fe.
16. Fr-Safe: Herbicide absorbent as manufactured by American Norit Company of Jacksonville, FL.

2.4 WATER

- A. Clean, fresh and potable, furnished and paid for by Owner.

2.5 SOIL MIXES

- A. Backfill Mixture for On-Grade Plant Pits: Thoroughly mix the following components into one (1cy) cubic yard of backfill mixture:
 1. Amount per Cubic Yard
 - a. 85% by volume of on-soil soil.
 - b. 15% by volume of organic compost
 - c. ¼ pounds ammonium sulfate
 - d. ¼ pounds of tripe super phosphate
 - e. ½ pounds agricultural gypsum
 - f. ½ pound potassium sulfate

PART 3 - EXECUTION

3.1 SOIL PREPARATION

- A. General:
 1. Moisture content: Do not work soil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in air or that clods will not break readily. Apply water, if necessary, to bring soil to an optimum moisture content for tilling and planting.
 2. Clearing of Debris: Clear all planting areas of stone 1 inch diameter and larger, weeds, debris and other extraneous materials prior to amending existing soil.
- B. Preparation of Existing Soil:
 1. Verification of Existing Grades: Verify that grades are within 1 inch plus or minus of the required finished grades. Report all variations to the Landscape Architect.
 2. Clearing of Debris: Clear all planting areas of stone 2 inch diameter and larger, weeds, debris and other extraneous materials prior to amending existing soil or spreading imported topsoil.

3. Cultivation: Rip or cultivate all planting areas to a depth of 6 inches immediately prior to amending existing soil. Rototill to reduce soil clods to a maximum diameter of one (1") inch in the top six (6) inches. Do not rototill within the existing tree areas.

3.2 SOIL CONDITIONING

- A. Amending of Imported Soil:
- B. Verification: Do not commence amending of soil prior to acceptance by Landscape Architect of soil preparation.
- C. Application Rate: Apply to all planting areas at the following rates per 1,000 square feet:
 1. 3 cubic yards organic amendment as specified.
 2. 5 pounds ammonium sulfate.
 3. 4 pounds triple super phosphate.
 4. 10 pounds Potassium Sulfate.
 5. 10 pounds agricultural gypsum.
- D. Incorporation of Amendments: Incorporate thoroughly with top 6 inches of soil layer and bring amended soil to finish grades and elevations shown on Drawing. Do not work soils under muddy conditions.
- E. Surface broadcast amendments at ½ the specified rate in the existing tree areas prior to hand soil conditioning or raking, do not otherwise incorporate.

3.3 DRAINAGE OF PLANTING AREAS

- A. Surface Drainage:
 1. Discrepancies: Provide proper surface drainage of planted areas. Submit in writing all discrepancies in the Drawings or Specifications, or prior work done by others, which Contractor feels precludes establishing proper drainage.
 2. Correction: Include description of work required for correction of relief of said condition.
- B. Detrimental Drainage, Soils and Obstructions:
 1. Notification: Submit in writing all soils or drainage conditions considered detrimental to growth of plant materials. State condition and submit proposal and cost estimate for correcting condition.
 2. Correction: Submit for acceptance a written proposal and cost estimate for the correction before proceeding with work.

3. Obstructions: If rock, underground construction work, tree roots, or other obstructions are encountered in the performance of work under this section, submit cost required to remove the obstructions to a depth of not less than 6 inches below the required soil depth.

3.4 CLEAN UP

- A. Keep all areas of work clean, neat and orderly at all times.
- B. Clean up and remove all deleterious materials and debris from the entire work area prior to Final Acceptance to the satisfaction of Landscape Architect.

END OF SECTION

SECTION 32 92 23

SODDING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide solid sodding for erosion control where shown on Drawings.

1.2 RELATED WORK

- A. Section 31 20 00 - Earth Moving
- B. Section 32 84 10 – Landscape Irrigation System.
- C. Section 32 93 00 - Plants

1.3 REFERENCES

- A. Federal Specifications (FS):
 - 1. FS-O-F-241 – Fertilizers, Mixed, Commercial.

1.4 QUALITY ASSURANCE

- A. American Sod Producers Association (ASPA) – Guideline Specifications to Sodding.

1.5 SUBMITTALS

- A. Submit results of soil analysis of samples taken from existing and/or imported topsoils.
- B. Submit samples of sod to Architect/Engineer for approval prior to installation.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver fertilizer in waterproof bags showing new weight, chemical analysis, and name of manufacturer.

1.7 PRICES

- A. Solid Sodding: Sodding in place as specified in this section and shown on the Drawings. Payment will be made at the lump sum bid for “Solid Sodding”, which price shall be full compensation for subgrade preparation, sod, lime, fertilizer, and water, including all labor, tools, equipment and incidental necessary to complete the work.

- B. Topsoil: Imported topsoil incorporated into Work as specified in this section and shown on the drawings. Payment will be made at the lump sum price bid for “Topsoil”, which price shall include all costs of purchasing the loading, hauling, dumping, and spreading topsoil at the site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:

1. Existing Topsoil: Natural, fertile agricultural soil capable of sustaining vigorous plant growth, not frozen or muddy condition, containing not less than 3% organic matter, and corrected to PH value of 5.9 to 7.0. Free from sub-soil, slag, clay, stone, lumps, live plants, roots, sticks, crabgrass, coughgrass, noxious weeds, and foreign matter.
2. Imported Topsoil: Natural, fertile agricultural soil typical of locality, capable of sustaining vigorous plant growth, from well-drained site free of flooding, not frozen or muddy condition, not less than 3% organic matter, and PH value of 5.9 to 7.0. Free from subsoil, slag, clay, stones, lumps, live plants, roots, sticks, crabgrass, coughgrass, noxious weeds, and foreign matter.
3. Have topsoils analyzed and submit written analysis stating the nitrogen, phosphorous, and potassium requirements, organic matter content, and ph value of the soil. Provide soil amendments as recommended by soils analysis.
4. Incorporate 15% compost by volume into existing and/or imported topsoil prior to planting or backfill mix preparation.

B. Fertilizers: FS O-F-241 commercial type:

1. Proportions: 10N-20P-10K, or as recommended by soils analysis. Provide fertilizer application as recommended by soils analysis.

C. Lime: Lime if required, shall be agricultural grade ground limestone ground to pass an 8-meshed sieve with 25 percent passing a 100-meshing sieve. Calcareous limestone shall contain not less than 50 percent calcium oxide, and dolomitic limestone shall contain not less than 40 percent magnesium oxide. Coarser materials will be accepted provided the specified rates of application are increased proportionality; on the basis of quantities passing the 8 and 100 mesh sieves, but no additional payment will be made for the increase quantity. Provide line application as required by soils ananlysis.

D. Sod: Conforming to ASPA Guideline.

1. Type: As specified in the Turf Materials list on the drawings.
2. Use certified nursery grade cultivated grass sod, 98% weed free.
3. Content: Strong fibrous root system and free from stones and burned or bare spots.

E. Water: Water shall be of irrigation quality and free of impurities that would be detrimental to plant growth.

PART 3 - EXECUTION

3.1 PREPARATION OF SUBGRADE

- A. Fine grade subgrade, eliminating uneven areas and low spots. Maintain lines, levels, profiles and contours, allowing for thickness of topsoil and sod. Make changes in grade gradual. Blend slopes into level areas. Allow for positive drainage.
- B. Remove foreign materials, undesirable plants, and their roots, stones, and debris. Do not bury foreign material beneath areas to be sodded. Remove subsoil which has been contaminated with petroleum or chemical products.
- C. Cultivate subsoil to a depth of 3 inches where topsoil is to be placed. Repeat cultivation in areas where equipment used for hauling and spreading topsoil has compacted topsoil.
- D. Prepare subgrades and bedding areas to receive plant materials.

3.2 PLACING TOPSOIL

- A. Spread topsoil to the minimum depth stated on the drawings over all areas to be sodded.
- B. Place topsoil during dry weather and on dry, unfrozen subgrade.
- C. Rake until surface is smooth.
- D. Remove stones, roots, grass weeds, debris, and other foreign non-organic material while spreading.
- E. Lightly compact area after application of lime and fertilizer.

3.3 LIME APPLICATION

- A. Spread lime at the rate recommended by soil analysis-lime requirement testing.
- B. Mix lime thoroughly into topsoil layer.

3.4 FERTILIZING

- A. Apply fertilizer at a rate of 800 pounds per acre or as recommended by soils analysis. Apply after fine grading and prior to compaction. Mix thoroughly into upper two inches of topsoil.
- B. Lightly water to aid the breakdown of fertilizer.
- C. Apply fertilizer within 48 hours before laying sod.

3.5 LAYING SOD

- A. Lay sod within 24 hours after delivery to prevent deterioration.
- B. Lay sod closely knit together with no open joints visible, and pieces not overlapped. Lay smooth and flush with adjoining grass areas, paving and top surfaces of curbs.
- C. On slopes 2.5:1 and steeper, lay sod perpendicular to slope and secure every row 6-inch long metal staples at maximum 2 feet on center. Drive metal staples flush with soil portion of sod.
- D. Immediately water sodded areas after installation. Water in sufficient amounts to saturate sod and upper 4 inches of soil.
- E. After sod and soil has dried sufficiently to prevent damage, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities. Ensure rolling equipment weight is not over 250lbs. or less than 150lbs.

3.6 MAINTENANCE SERVICE

- A. Begin maintenance services of sodded areas immediately after installation and continue throughout construction period until final acceptance of work.
- B. Establish and maintain turf in a vigorous healthy growing condition. Include the following items:
 - 1. Mowing turf as necessary to maintain a height of grass above ground between 2 and 4 inches.
 - 2. Water sufficient to saturate root system.
 - 3. Weed control applications.
 - 4. Disease and insect control.
 - 5. Fertilize every 30 days following initial application and installation.

END OF SECTION

SECTION 32 93 00

PLANTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Trees, plants, and ground cover.
- B. Tree pit and plant bed preparation.
- C. Temporary support.
- D. Maintenance service.

1.2 RELATED WORK

- A. Section 31 20 00 - Earth Moving
- B. Section 32 84 00 - Planting Irrigation.
- C. Section 32 91 13 Soil Preparation
- D. Section 32 92 23 - Sodding

1.3 QUALITY ASURANCE

- A. Perform work with personnel experienced in the work required of this Section under direction of a skilled foreman.
- B. Plant material: American Association of Nurserymen, Inc. Standards.
 - 1. Grading tolerances allowed: As specified in the American Standard for Nursery Stock, latest revised edition.
 - 2. Material shall be free from disease and insect infestation.

1.4 SUBMITTALS

- A. Submit samples of plant materials to Architect/Engineer for approval prior to installation.
- B. Submit a five-pound sample of prepared backfill mixture. If an alternate pre-mixed type is proposed, then submit sample and mix contents by proportion.
- C. Submit a five-pound sample of mulch material.
- D. Submit results of soils analysis for exiting and/or imported topsoils used in backfill mixture, and existing subgrade soils.

1.5 REFERENCES

- A. Federal Specification (FS): FS O-F-241 –Fertilizer, Mixed Commercial.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Move balled and burlapped stock only when root balls are solid and well hardened.
- B. Deliver plant materials immediately prior to placement. Keep root balls of plant material moist.
- C. Reject plants when root ball has been cracked or broken prior to or during process of planting.
- D. Reject plants when burlap, staves, and ropes required in connection with transplanting have been displaced prior to acceptance.

1.7 WARRANTY

- A. Provide one-year warranty from date of final acceptance of the work.
- B. Immediately replace plant materials found dead, or not in healthy growing condition during warranty coverage.
- C. Replacements: Plant materials of same size and species, with a new warranty commencing on date of replacement.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil and Backfill Mixture:
 - 1. Refer to Section 32 91 13 Soil Preparation.
- B. Fertilizers:
 - 1. Ref. Soil Preparation Spec.
 - 2. Fertilizer: AGRIFORM planting tablets by Sierra chemical Company, or approved equal.
 - a. Trees and Shrubs: 21 gram planting tablet.
 - b. Liner size plants: 10 gram planting tablet.
 - c. Ground cover, each plant: 5 gram planting tablet.
- C. Trees, Shrubs, and Ground Cover:
 - 1. Refer to Plant Materials list on Drawings.
 - 2. Furnish either balled and burlapped or container grown stock.
- D. Weed control:

1. Anti-germination weed control agent, EPTAM, or approved equal. Place under mulch in shrub and groundcover beds at manufacturer's recommended rates.
- E. Plant Growth Stimulator:
 1. Water all plants at installation with a liquid from root stimulator. Saturate planting holes thoroughly.
- F. Mulch Material:
 1. Shredded Hardwood bark with no hardwood chips, limbs or other foreign material.
- G. Steel Edging:
 1. 3/16" x 4" Steel Edging band.
 2. Pre-formed stake straps, stakes and end stakes.
 3. Rust resistant painted finish.

2.2 ACCESSORIES

- A. Wrapping Materials: Quality burlap.
- B. Tree anchoring materials in accordance with tree anchoring method specified in the drawings.

PART 3 - EXECUTION

3.1 PREPARATION, GENERAL

- A. Verify that the site is ready to receive the work of this Section.
- B. Prepare subgrades and bedding areas to receive plant materials.
- C. Enclose all open plan bed edges with steel edging. Do not place edging along backs of curbs or pavements.

3.2 PREPARATION OF SUBGRADE

- A. Remove foreign materials, undesirable plants and their roots, stones and debris. Do not bury foreign material beneath areas to be backfilled and planted. Remove subsoil which has been contaminated with petroleum or chemical products.
- B. Excavate ground cover and annual beds to the minimum depth below finish grade required for the backfill mixture layer depth specified in the drawings.
- C. Excavate tree and plant pits as shown in the drawings, allowing for depth of root ball and proper finish grade at top.

- D. Cultivate sub-soil to a depth of 3 inches where backfill mixture to be placed. Repeat cultivation in areas where equipment used for hauling and spreading topsoil has compacted sub-soil.

3.3 PLACING BACKFILL

- A. Mix any granular fertilizers thoroughly with backfill mixture prior to backfilling.
- B. Backfill plant pits with backfill mixture mounded to finish grade when installing plants.
- C. Backfill ground cover and annual beds to finish grade with the minimum layer depth stated on the drawings for backfill mixture.
- D. Backfill other bed areas to finish grade with the minimum layer depth of topsoil as specified in the drawings.
- E. Place topsoil and prepared backfill mixture during dry weather and on dry, unfrozen subgrade.
- F. Grade bed areas to eliminate rough and low areas, ensuring positive drainage. Maintain levels, profiles and contours of subgrade.

3.4 INSTALLATION OF PLANT MATERIALS

- A. Place plant materials for review and final orientation by Architect/Engineer prior to installation.
- B. Handle nursery stock in accordance with good nursery practice.
- C. Scarify walls and bottoms of planting pits where soil is compacted or glazed.
- D. Place trees and shrubs in pits and backfill with prepared backfill mixture. Place ground Covers and annuals in beds backfilled with prepared backfill mixture.
- E. Tablet Fertilizing:
 - 1. Place one planting tablet in each planting hole, using the proper size for each type of planting:
 - a. Trees and shrubs: 21 gram.
 - b. Liner size plants: 10 gram.
 - c. Ground Cover plants: 5 gram
 - 2. Place tablet so as not to physically interfere with the existing roots at the time of planting.
 - 3. Laterally, place tablet just about one inch beyond the existing root system where feeder root development will occur.
- F. Stabilize trees over 5-feet height in upright position in accordance with tree anchoring method specified in drawings.
- G. Apply weed control agent to finished grade of planted bed areas prior to installing mulch material.

- H. Apply liquid from root stimulator with initial watering.
- I. Provide 3-inch minimum settled layer depth of mulch in all planted beds and around the base of all newly planted trees.
- J. Maintain plantings throughout construction period until date of final acceptance.

3.5 MAINTENANCE SERVICE

- A. Begin maintenance of tree and shrub plantings immediately after planting and continue throughout construction period until final acceptance of work.
- B. Maintenance shall include measures necessary to establish and maintain plants in a vigorous and healthy growing condition, including the following items:
 - 1. Cultivation and weeding plant beds and tree pits. When herbicides are used for weed control, apply in accordance with manufacturer's instructions. Remedy damage resulting from use of herbicides.
 - 2. Water sufficient to saturate root system.
 - 3. Pruning, including removal of dead or broken branches, shaping and treatment of prune wounds.
 - 4. Disease and insect control.
 - 5. Maintenance of tree anchors. Adjust repair or replace as required to maintain trees in upright positions.
 - 6. Replace mulch and backfill mixture and/or topsoil after washouts.
 - 7. Immediately replace plant material found dead or not in healthy growing condition.
 - 8. Fertilize trees, shrubs and ground covers every 30 days after installation.

END OF SECTION

SECTION 33 05 16
MANHOLE AND STRUCTURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Excavate for the following structures:
- B. Shore and brace excavations as required.
- C. Backfill and compact structures to required elevations and densities.
- D. Dewater excavations.

1.2 RELATED WORK

- A. Section 31 20 00 – Earth Moving.
- B. Section 32 05 23 – Cement and Concrete For Exterior Improvements.
- C. Section 33 40 00 – Storm Drainage Utilities.

1.3 SUBMITTALS

- A. See Related Work

1.4 PROTECTION

- A. Protect trees that are to remain, and other features remaining as part of final landscaping.
- B. Protect benchmarks, site corner pins, and existing street paving against damage from equipment and vehicular or foot traffic.
- C. Protect excavations by shoring, bracing, sheet piling, underpinning, or other method, as required to prevent cave-ins or loose dirt from falling into excavations.
- D. Underpin adjacent structures, which may be damaged by excavation work, including service lines and pip chases.
- E. Notify Architect/Engineer of unexpected sub-surface conditions and discontinue work in area until Architect/Engineer provides notification to resume work.
- F. Protect bottom of excavations and soil around and beneath foundations from frost or freezing and water inundation.
- G. Grade around excavations to prevent surface water run-off into excavated areas.

PART 2 - PRODUCTS

2.1 SUITABLE BACKFILL MATERIALS

- A. Gravel: Angular crushed natural stone free shale, clay, friable materials, and debris.
- B. Pea Gravel: Clean natural stone free from clay, shale, and organic matter.
- C. Sand: clean natural river or bank sand free from slit, clay, loam, friable or soluble materials, and organic matter.
- D. Under areas not to be paved: Sub-soil free from roots, rock larger than 3 inches in size, and building debris.
- E. Under structures or areas to be paved: Material meeting requirements for controlled fill as specified in Section 31 20 00.
- F. Drainage fill: Evenly graded mixture of crushed stone or washed crushed or uncrushed gravel with 100% by weight passing a 1-1/2 inch not more than 5% by weight passing a No. 4 sieve.

PART 3 - EXECUTION

3.1 PREPARATION AND LAYOUT

- A. Establish extent of excavation by area and elevation: designate and identify datum elevation.
- B. Set required lines and levels.
- C. Maintain bench marks, monuments and other reference points.

3.2 UTILITIES

- A. Before starting excavation, establish location and extent of underground utilities occurring in work area.
- B. Notify utility companies of lines which are in the way of excavation.
- C. Protect existing utility lines to remain which pass through work area.
- D. Protect utility services uncovered by excavation.

3.3 EXCAVATION

- A. Excavate sub-soil in accordance with lines and levels required for construction of the work, including space for forms, bracing and shoring, and to permit inspection.
- B. Do additional excavation only by written authorization of Architect/Engineer.

- C. Adjust pad footing depth when directed by Architect/Engineer to reach satisfactory bearing.
- D. Hand trim excavation and leave free from loose or organic material.
- E. Keep all excavations dry by pumping or draining water from the work.
- F. Pour footings the same way that excavations are made, and do not allow water to stand in excavated footing trench.
- G. When excavation is complete, allow Architect/Engineer to inspect sub-soil bearing condition before footing trench.
- H. Undercut unavoidably submerged footing excavations to unaltered soils.
- I. Fill over-excavated sub-soil for re-use where directed. Remove excess or unsuitable excavated sub-soil from site.
- J. Do not interfere with normal 45 degree bearing splay of any foundation.
- K. Stockpile excavated sub-soil for re-use where directed. Remove excess or unsuitable excavated sub-soil from site.
- L. Do not disturb soil within branch spread of existing trees or shrubs that are to remain.

3.4 BACKFILLING

- A. Ensure areas to be backfilled are free from debris, snow, ice, and water, and that ground surfaces are not in a frozen condition.
- B. Backfill areas to grades, contours, levels, and elevations.
- C. Backfill systematically and as early as possible to allow maximum time for natural settlement and compaction.
- D. Compact backfill with mechanical tampers approved by Architect/Engineer.
- E. Place and compact backfill materials in continuous layers not exceeding 6 inches loose depth.
- F. Maintain optimum moisture content of backfill materials to attain required compaction density.
- G. Backfill freestanding structures on both sides at the same time in thin, equal layers to provide balanced pressures.
- H. Where temporary unbalanced pressures are liable to develop on walls, erect necessary shoring to counteract imbalance. Leave in place until their removal is approved by Architect/Engineer.

3.5 FILL TYPES AND COMPACTION

- A. Backfill under areas not to be paved: Compact with mechanical tampers until material is as firm and unyielding as the surrounding material undisturbed by excavation.

- B. Backfill in compacted fill and under paving areas: compact to top of subgrade to density requirements specified in Section 31 20 00.
- C. Fill under landscape areas: Sub-soil to within 4 inches of finish grade elevation.

3.6 SURPLUS MATERIALS

- A. Remove surplus excavation or backfill materials from site.
- B. Leave stockpile areas completely free of all excess fill materials.

END OF SECTION

SECTION 33 11 00
WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Providing water line pipe, fittings, and appurtenances.

1.2 RELATED WORK

- A. Section 32 05 23 –Cement & Concrete for exterior improvements
- B. Section 33 12 19 – Water Utility Distribution Fire Hydrants
- C. Section 33 12 10 – Ductile Iron Pipe and Fittings.

1.3 SYSTEM DESCRIPTION

- A. Relocating existing fire hydrants and appurtenances.

1.4 QUALITY ASSURANCE

- A. Construct water lines and appurtenances in accordance with the referenced portions of the "Standard Pipeline Construction Specification" published by the Utility Authority having jurisdiction. Should conflicts occur between the Drawings and these Specifications, the Utility Authority's "Standard Pipeline Construction Specifications" shall govern.

1.5 REFERENCE STANDARDS

- A. Utility Authority's "Standard Pipeline Construction Specifications," Latest Edition, hereafter referred to as the "Standard Specifications".
- B. Arkansas Department of Health "Rules and Regulations Pertaining to Public Water Systems."
- C. In the event that a conflict arises between the submitted project plans and specifications and the above standards , then the more stringent interpretation shall control.

1.6 SUBMITTALS

- A. See Related Work

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Handling Pipeline Materials, of the Specifications-Construction section of the Standard Specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe and Fittings: Refer to Section 33 12 10.
- B. Valves and Hydrants: Refer to Section 33 12 19.
- C. Ductile Iron Pipe, 4"-12" – See Specification Section 33 12 10.
- D. PVC pipe, 2" and 3":
 - 1. General: PVC (Polyvinyl Chloride) pipe shall be made from Type 1, Grade 1, Polyvinyl Chloride plastic conforming to ASTM D1784 and CS-256. The pipe shall conform to ASTM D2241 as it applies to Type 1, Grade 1, Polyvinyl Chloride plastic, SDR 17, water pressure rating of 250 psi. The pipe and fitting shall conform to the specifications of the National Sanitation Foundation Testing Laboratories, Ann Arbor, Michigan, and AWWA standards C605-05, C651-05, and C900-07.
 - 2. Pipe Joints: The joints shall be designed so that the pipe and fittings shall be connected on the job with the use of rubber gaskets. The pipe and fittings shall have a push-on joint consisting of a single rubber gasket designed to be assembled by the positioning of a continuous, molded rubber ring gasket in a recess in the joint, thereby compressing the gasket radially to the pipe to form a positive seal. The gasket and the angular recess shall be so designed and shaped that the gasket is locked in place against displacement as the joint is assembled. Gasket dimensions shall be in accordance with manufacturer's standard design dimensions and tolerances and shall be of such size and shape as to provide an adequate compressive force against the plain end and socket after assembly to effect a positive seal under all combinations of joint and gasket tolerances. Gaskets shall be vulcanized natural or vulcanized synthetic rubber. The joint shall be designed to withstand the same pressure required for the pipe. All plain ends should be extended into the socket. The joint shall be designed so as to provide for the thermal expansion or contraction experienced with a temperature change of at least 75 degrees F. Plain end by plain end pipe connected by a coupling provided with rubber gaskets and a center stop will be acceptable.
 - 3. Pipe Length: Manufacturer's standard lengths of 18 to 20 feet.
 - 4. Fittings: Fittings and specials connecting with pipe shall conform to AWWA short or long bodied cast iron fittings using a mechanical joint system with hardened or duck tipped type of rubber gaskets in accordance with AWWA specifications C110 and C153. Refer to Section 33 12 10.

5. Markings: All PVC pipe and fittings shall have the following data applied to each piece:
- a. Nominal size.
 - b. Type of material.
 - c. SDR or Class.
 - d. Manufacturer's name.
 - e. NSF (National Sanitation Foundation) seal of approval.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Location, alignment, and grade: Refer to the Specifications – Construction Section of the "Standard Specifications".
- B. Location and protection of surface and subsurface structures: Refer to Article 7 of the Specifications - Construction Section of the "Standard Specifications".
- C. Protection of vegetation: Refer to the Specifications - Construction Section of the "Standard Specifications".
- D. Tie-in notification:
 - 1. Notify the Utility Authority having jurisdiction in writing of date and time that 6 inch and larger tie-ins to existing system are to be made.
 - 2. Written notification must be received by the Water Works 24 hours in advance of tie-in.

3.2 INSTALLATION

- A. Excavate and prepare the trench in accordance with the Specifications - Construction Section of the "Standard Specifications".
- B. Install joint pipe and fittings in accordance with the Specifications - Construction Section of the "Standard Specifications".
- C. Install concrete blocking in accordance with the Specifications – Construction Section of the "Standard Specifications".
- D. Perform backfilling and bedding in accordance with the Specifications - Construction Section of the "Standard Specifications".
- E. Make connections to the existing distribution system in accordance with the Specifications - Construction Section of the "Standard Specifications".

3.3 TESTING AND STERILIZATION

- A. Filling of the line shall only be done through an approved "Fill Connection" installed by the contractor as indicated on the plans or directed by the Engineer. Disinfection shall be done in

accordance to ANSI/AWWA C651-05 and the AHJ using either liquid chlorine, sodium hyperchlorite solution, or calcium hypochlorite granules or tablets.

- B. Pressure Testing the newly constructed portions of the water distribution system in accordance with ANSI/AWWA C605-06. The test pressure shall be 225 psi at the highest point or as specified by the AHJ. The test shall be two hours with a maximum pressure loss of 5 psi and the maximum leakage per hour shall be $Q=(LDP^{0.5})/148,000$ (P=Quantity of makeup water, gpm; L=Length of pipe, feet; D=Nominal pipe diameter, inches; P= Test pressure, psi. Testing on tapping sleeves/saddles must have zero leakage to be considered successful.
- C. Contractor shall flush new water line and provide Arkansas Department of Health with (2) bacteriological water samples from two consecutive days for testing by ADH labs. Samples must be determined to be "safe" by ADH labs prior to placing new water main into service.

3.4 WORK PERFORMED BY THE WATER UTILITY

- A. The Utility Authority having jurisdiction will assist the Contractor in emergencies in accordance with and under the terms of the Specifications - Construction Section of the "Standard Specifications".

3.5 DAMAGE TO EXISTING DISTRIBUTION SYSTEM

- A. Repair damage to the Utility Authority having jurisdiction system in accordance with the Specifications - Construction Section of the "Standard Specifications".

END OF SECTION

SECTION 33 12 10
DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnishing ductile iron pipe and cast iron or ductile fittings for utility line construction.

1.2 RELATED WORK

- A. Section 32 12 19 – Water Utility Distribution Fire Hydrants
- B. Section 33 11 00 – Water Utility Distribution Piping
- C. Section 33 31 00 - Sanitary Utility Sewerage Piping

1.3 SUBMITTALS

- A. See Related Work

1.4 REFERENCE STANDARDS

- A. AMERICAN WATER WORKS ASSOCIATION (AWWA):
 - 1. AWWA Standards.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. American Cast Iron Pipe Co.
- B. Atlanta States Cast Iron Pipe Co.
- C. MCWane Cast Iron Pipe Co.
- D. Pacific States Cast Iron Pipe Co.
- E. U.S. Pipe and Foundry Co.

2.2 PIPE

- A. Ductile Iron: Pipe manufactured in accordance with ANSI A21.51 (AWWA C151).
 - 1. Working pressure: 200psi
 - 2. Metal wall thickness class:
 - a. Size 4” -54: Class 50
 - b. Flanged: Class 53

3. Cement mortar lining and seal coat: ANSI A21.4 (AWWA C104)

2.3 POLYETHYLENE ENCASEMENT

A. Materials

1. Linear low-density polyethylene film. Linear low-density polyethylene film shall be manufactured from virgin polyethylene material, either in flat tube or sheet form, conforming to the following:

- a. Raw Material requirements, per ASTM D4976

Group: 2 (linear)

Density: 0.910 to 0.935 g/cm³

Dielectric strength: Volume resistivity, 10¹⁵ ohm-cm, minimum

- b. Physical properties of finished film.

Tensile strength: 3,600 psi (24.8 MPa), minimum in machine and transverse direction (ASTM D882)

Elongation: 800 percent, minimum in machine and transverse direction (ASTM D882)

Dielectric strength: 800 V/mil (31.8 V/μm) thickness, minimum (ASTM D149)

Impact resistance: 600 g, minimum (ASTM D1709 Method B)

Propagation tear resistance: 2,550 gf (grams force), minimum in machine and transverse direction (ASTM D1922)

- c. Thickness. Linear low-density polyethylene film shall have a minimum thickness of 0.008 in. (8 mil or 200 μm).
- d. Installation of polyethylene encasement that does not meet these standards shall not be permitted under any circumstances.

B. Marking

1. Marking requirements. The polyethylene film supplied shall be clearly marked, at a minimum of every 2 ft along its length, containing the following information:
 - a. Manufacturer's name or trademark
 - b. Year of manufacture.
 - c. ANSI/AWWA C105/A21.5.
 - d. minimum film thickness and material type (LLDPE or HDCLPE).
 - e. Applicable range of nominal pipe diameter size(s).
 - f. Warning--Corrosion Protection--Repair Any Damage.

2. Marking height. Letters and numerals used for marking items shall not be less than 1 in. in height. Warning label shall not be less than 1 1/2 in. in height.

2.4 FITTINGS

- A. Design working pressure: 250 psi in accordance with ANSI A21.10 (AWWA C110).
- B. Cement mortar lining and seal coat (except sleeves and plugs): ANSI A 21.4
- C. JOINTS:
 - 1. Manufactured according to ANSI A21.11 (AWWA C111).
 - a. Manufactured according to ANSI A21.11 (AWWA C111).
 - b. Furnished with cast iron glands, cast iron bolts and nuts, and plain rubber gaskets.
 - 2. Push-on –joint
 - a. Body thickness and radii of curvature: ANSI A21.10 (AWWA C110).
 - b. Joint: ANSI A21.11 (AWWA C111).

2.5 ANCHOR FITTINGS

- A. Design working pressure: 250 psi.
- B. Designed to fit standard mechanical joint fittings (AWWA C111).
- C. Furnish with 360 degree rotating gland on one end integral cast follower gland on the other, with protruding plain ends.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Water line construction under jurisdiction of the Utility authority having jurisdiction.

END OF SECTION

SECTION 33 12 19
WATER UTILITY DISTRIBUTION FIRE HYDRANTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Providing fire hydrants and valves for water line construction.

1.2 RELATED WORK

- A. Section 33 11 00 – Water Utility Distribution piping
- B. Section 33 12 10 - Ductile Iron Pipe and Fittings

1.3 SUBMITTALS

- A. See Related Work

1.4 REFERENCE STANDARDS

- A. American Water Works Association (AWWA):
 - 1. AWWA C500/C515- Gate Valves – 3 inch through 48 inch for Water and other liquids.
 - 2. AWWA C502 – Fire Hydrants for Ordinary Water Works Service.
 - 3. AWWA C501 – Rubber seated Butterfly Valves.

PART 2 - PRODUCTS

2.1 MANUFACTURES

- A. Gate Valves:
 - 1. Mueller Company, Decatur, Illinois.
 - 2. Kennedy Valve Manufacturing Company, Elmira, New York.
 - 3. Clow Corporation, Oskaloosa, Iowa.
 - 4. Waterous, St. Paul, Minnesota.

2.2 MATERIAL

- A. Gate Valves:
 - 1. Conform to AWWA C509.

2. Design working pressure: 200 psi.
 3. Bronze mounted Iron bonnet, non-rising stem, double-disc parallel seat type, O-ring stem seals.
 4. 2 inch x 2 inch square operating nut.
 5. Valves shall open when operating nut is turned clockwise.
 6. Coating complying to AWWA C550.
- B. Gate Valves used with tapping sleeves: Use resilient seat type.
- C. Valve Boxes:
1. Equal to Mueller Co., #M-10364, 562-A.
 2. Two-piece, sliding type, 5¼ inch shaft, 24-36 inch extensions.
 3. Drop cover with word "Water" cast into top surface.
- D. Concrete and Steel for thrust blocks and collars: Refer to Section 32 05 23.

2.3 BEDDING AND BACKFILL MATERIALS

- A. Class I Bedding Material: Angular, graded stone, ¼ inch to 1½ inch size.

PART 3 - EXECUTION

3.1 INSTALLING VALVES

- A. Setting valves:
1. Place valves in pipelines at points designated.
 2. Cut pipes to proper length and bevel ends as specified in this section.
 3. Place valve with stem vertical with clearance for installation of valve box.
 4. Place valve on firm soil or on blocking as shown on Detail Drawing.
- B. Jointing Valves:
1. Joint valves in accordance with methods of jointing pipe as specified in this section.
 2. Joint valves with mechanical joint ends as specified in this section for mechanical joint pipe and fittings.
- C. Setting valve boxes:

1. Install valve boxes over operating nut of each valve.
2. Ensure that box is of adequate length to reach finish ground or paved surface.
3. Provide valve stem extension on valve when height to finished surface exceeds five feet.

END OF SECTION

SECTION 33 31 00

SANITARY UTILITY SEWERAGE PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A.** Providing sanitary sewer gravity lines and related appurtenances shown on the Drawings.

1.2 RELATED WORK

- A.** Section 32 05 23 – Cement & Concrete for exterior improvements
- B.** Section 33 12 10 - Ductile Iron Pipe & Fittings
- C.** Section 33 39 00 - Sanitary Utility Sewerage Structures

1.3 SUBMITTALS

- A.** See Related Work

1.4 REFERENCE STANDARDS

- A.** American Society for Testing and Materials (ASTM).
 - 1. ASTM D3033 Specifications for Type PSP Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings.
 - 2. ASTM D3034 Specifications for Type PSM Poly Vinyl Chloride (PVC) Thermoplastic Sewer Pipe.
- B.** City of Little Rock Wastewater Utility – Specification Requirements for Sanitary Sewers (Latest Edition). Should conflicts occur between the Drawings and these specifications, the City of Little Rock Wastewater Utility specifications will govern.
- C.** Uni-Bell PVC Pipe Association - UNI-B-6 – Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe (Latest Edition), Should conflicts occur between the drawings and these Specifications, the UNI-B-6 will govern.

PART 2 - PRODUCTS

2.1 PIPE MATERIAL

- A.** Ductile Iron Pipe: Refer to Section 33 12 10 Ductile Iron Pipe & Fittings.
- B.** PVC Sewer Pipe (PSM): ASTM D3034.
 - 1. Material: Poly vinyl chloride have cell classification of 12454-B, with Minimum tensile modules of 500,000 psi, as defined in ASTM D1784.

2. Minimum wall thickness: SDR-26.
3. Joints: Compression-type flexible gasketed joints with gasket confined in machine groove in spigot end of pipe.
4. Length: Manufacturer's standard length not to exceed 20 feet.

C. PVC Corrugated Sewer Pipe:

1. Material: Poly vinyl chloride have cell classification of 12454-B, with minimum tensile modules as defined in ASTM D 1784.
2. Minimum pipe stiffness: 115 psi, when measured in accordance with ASTM Test Method D2412.
3. Joints: All joints shall be soil/water tight joints made with integrally formed bell and spigot gasketed connections. Elastomeric seals (gaskets) shall meet the requirements of ASTM Designation F477.
4. Length: Manufacturer's standard length not to exceed 20 feet.

2.2 CONCRETE MORTAR

- A.** Mix one part Portland cement with four parts sand and add minimum quantity of water as necessary to provide workable mortar.

2.3 BEDDING AND BACKFILL MATERIALS

- A.** Class I Bedding Material: Angular, graded stone, ¼ inch to 1½ inch size.

PART 3 - EXECUTION

3.1 EXCAVATION GENERAL

- A.** Excavate to line and grade shown on drawings or as established on the site.
- B.** When excavation is carried below that required, fill space with concrete, or gravel or compacted select material.
- C.** Provide sheeting and shoring where necessary to protect workmen, the work, or adjacent property.
1. Leave shoring in place until backfill has proceeded to point where it can be safely removed.
- D.** De-water excavations before undertaking and construction therein.
1. Place concrete only upon dry, firm foundation material.

2. Lay pipe only in dry trenches or on dry bedding.

3.2 EXCAVATION - TRENCH

- A. Excavate trench widths within limits established as follows for pipe size used:

<u>Nominal Pipe Diameter</u>	<u>Min. Width of Trench</u>	<u>Max. Width of Trench 12" Above Top of Pipe</u>
6"	1'-6"	2'-6"
8"	1'-8"	2'-8"
10"	1'-10"	2'-10"

- B. If necessary to reduce earth load on trench banks to prevent sliding and caving, cut trench banks on slope above an elevation two feet above outside top of pipe.
- C. Keep sides of excavation vertical from bottom of trench to 12 inches above top of pipe.
- D. For rigid pipe not requiring bedding material under pipe, excavate trench to grade of bottom of pipe barrel so as to allow flowline of pipe to be laid at designated grade. Ensure that trench bottom is firm, dry, and free of loose material. If water is standing or flowing into trench bottom, attempt to provide dry, firm soil foundation for pipe by pumping water out of below grade sump before over-excavating and backfilling with gravel.
- E. Where granular bedding material under pipe is specified, excavate to below designated grade of pipe barrel to allow for 6" of bedding material. Grade bottom of trench approximately level across, and within 0.05 foot of designated slope of line at any point. Ensure that trench bottom is firm, dry, and free of loose material.
- F. If soil trench bottom below pipe barrel or below bedding material is mucky, or too soft to properly support the pipe, or in such condition that it cannot be properly shaped and graded, excavate to a minimum depth of 6 inches below normal subgrade elevation to firm soil and refill with Class I bedding material to the pipe subgrade elevation.
- G. Where water occurs in trenches after placement of bedding material or gravel backfill, and the foundation is otherwise stable, pump water out of trench from sump below gravel so as to hold water level below bottom of pipe until joints have been placed and pipe firmly bedded in position and jointed. This work of dewatering shall be included in the price bid for sewer line construction.
- H. Do not excavate more than 100 feet ahead of pipe installation and backfill, except by permission of Engineer.
- I. Direct surface runoff water away from trenches into existing drainage structures and ditches in such a manner as to prevent flooding of streets or private property.

- J.** Pile excavated material in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Keep street drainage swales clear or make other satisfactory provision or street drainage.
- K.** Remove excess material and material unsuitable for backfilling from public rights of way and utility line easements.

3.3 BEDDING AND BACKFILLING SEWER LINES

A. Bedding of rigid pipe:

1. Grade trench bottom or bedding material to provide full-length support of pipe barrel to designated slop of line.
2. Excavate for bells or other joint protrusions.
3. Bed ductile iron pipe using Type 2 laying condition.
4. Lay pipe as specified in this section.
5. Hand-place bedding material in trench bottom on each side using either Class I material or select material at proper moisture content.
6. Slice-in bedding material with shovels under pipe haunches to eliminate voids and provide side support.
7. Bring material up evenly on each side of pipe to centerline of pipe along full width of trench.
8. If select material is used, place material in maximum 4-inch layers and consolidate with hand tamps up to pipe centerline.

B. Bedding flexible pipe:

1. General: Refer to Standard Detail bound in Project Manual.
2. Use Class I bedding material for bedding, haunching, and initial backfill.
3. Grade bedding material to provide full-length support of pipe barrel at designated slope of line.
4. Excavate for bells.
5. Place and joint pipe as specified in this section.
6. Hand place Class I material in thin layers on each side of pipe without disturbing line or grade of pipe.
7. Slice-in bedding material with shovel under pipe and above top of pipe a minimum of 6".

C. Backfilling – rigid pipe:

1. Begin backfilling immediately after pipe laying and embedment.
2. Hand-place select material to a point of 12 inches above top of pipe in such manner as to minimize voids.
3. Backfill trenches not under structures, or paving areas, or improved areas with excavated materials or sub-soil up to surrounding ground surface.
 - a. Do not use material of a perishable, spongy, or otherwise unsuitable nature and do not place rocks larger than 6 inches in greatest dimension within 36 inches of top of pipe.
 - b. Do not pack rock larger than 1-1/2 inches in greatest dimension within 12 inches of top of pipe.
 - c. Leave trench slightly mounded above top of pipe to allow for settlement.
4. Under structures, vehicle traffic areas, or improved areas backfill trench from above top of initial backfill to top of subgrade with select material or other approved cohesive material.
 - a. Place material in uniform layers of maximum 6-inch loose thickness and compact each layer up to a point of 24 inches below subgrade to a density of 90% of optimum density as determined by ASTM D1557, Modified Proctor procedures.
 - b. Compact remaining 24 inches to 95% of the same optimum density.

D. Backfilling-flexible pipe:

1. Hand place select material to a point 12 inches above top of pipe in such manner as to minimize voids.
2. Backfill trenches not under structures, or paving areas, or improved areas with excavated materials or sub-soil up to surrounding ground surface.
 - a. Do not use material of a perishable, spongy, or otherwise unsuitable nature and do not place rocks larger than 6 inches in greatest dimension within 36 inches of top of pipe.
 - b. Do not pack rock larger than 1-1/2 inches in greatest dimension within 12 inches of top of pipe.
 - c. Leave trench slightly mounded above top of pipe to allow for settlement.
3. Under structures, vehicle traffic areas, or improved areas backfill trench from above top of initial backfill to top of subgrade with select material or other approved cohesive material.
 - a. Place material in uniform layers of maximum 6-inch loose thickness and compact each layer up to a point of 24 inches below subgrade to a density of 90% of optimum density as determined by ASTM D1557, Modified Proctor procedures.
 - b. Compact remaining 24 inches to 95% of the same optimum density.

E. Maintaining trenches:

1. Maintain top of trenches during warranty period of contract, adding material as backfill material settles.

2. Maintain road and sidewalk crossings until pavement has been placed.

3.4 LAYING PIPE

A. Placing gravity sewer lines:

1. Carefully inspect each joint of pipe before it is placed in trench, making sure not foreign material is inside pipe and that it is sound and free from cracks. Plainly mark damaged joints in such a manner that marking will not rub or wash off and remove joint from site as soon as possible.
2. Lower pipe carefully into trench in such manner that spigot and bell will not become contaminated.
3. Grade bedding material to provide full-length support of pipe barrel at designated slope of line.
4. Excavate for bells.
5. If cutting of pipe is necessary, make cut straightly and smoothly without damage to pipe, removing all burrs.
6. Lay sewer pipe with bell facing up-stream.
7. Lay pipe to designated line and grade, using batter boards and topline, or laser beam grade light.
8. Do not lay pipe in water or when trench conditions or weather is unsuitable for such work.
9. Place pipe-on bedding prepared as specified in this Section.

B. Jointing push-on pipe:

1. Check inside of pipe barrel for cleanliness.
2. Thoroughly clean bell and spigot ends of pipe, especially the gasket seat, using wire brush as necessary.
3. Clean and insert rubber gasket in seat within bell.
4. Apply lubricant as recommended by pipe manufacturer.
5. Insert spigot end into bell of pipe to which connection is being made and force to firm contact with shoulder or bell.

C. At end of each day's work, and when laying of pipe must be discontinued for an appreciable period, close open ends of pipe temporarily to prevent foreign matter and water from entering.

3.5 SEPARATION OF WATER AND SEWER LINES

- A. Do not lay sewer lines closer horizontally than 10 feet from any water line.
- B. Where gravity sewer lines cross water lines, lay pipe with minimum 18 inches vertical separation between pipe barrels. Lay so that a full joint of pipe is centered on water line so as to have the maximum distance between joints.

3.6 CONNECTION TO EXISTING MANHOLE

- A. Do not make connection to existing manhole until other manhole and sewer lines have been completed, cleaned, tested, and approved for connection to existing manhole by the Utility or the Owner's representative.
- B. Cut hole of sufficient size in wall of existing manhole to permit proper installation of proposed pipe at designated line and grade.
- C. Extend pipe entirely through wall of manhole and fill opening around pipe with concrete or concrete mortar, plastering surface on both sides with concrete mortar so that no leakage will occur.

3.7 AIR TESTING

- A. General: Perform air leakage test of joints of sewer mains in presence of representative of the Utility. Notify 48 hours before planned time to begin testing.

1. Performance

The pipe shall be pressurized to 5 pounds per square inch gauge (psig) greater than the pressure exerted by groundwater above pipe. Once the pressure is stable, the minimum time allowable for the pressure to drop 1.0 psig shall be 5 minutes per every 100 feet of pipe plus (+) 5 minutes per each service connection. Pipe sizes larger than 27 inches shall be tested by the local governing authority.

The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test shall continue for the entire testing duration as outlined in the paragraph before or until failure.

2. Procedure

Add air until the internal air pressure of the sewer line is raised to approximately 5.5 psig. Allow the air pressure to stabilize. The pressure will normally drop until the temperature of the air in the line stabilizes.

When the pressure has stabilized and is at or above the starting test pressure of 5 psig, commence the test by allowing the gauge pressure to drop to 5 psig at which point the time recording is initiated. Record the drop in pressure for the test period.

- B. Perform low-pressure air test in accordance with UNI-B-6. Tables I and II from this specification are included below:

UNI-B-6-98

TABLE I
MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015

1 Pipe Diameter (in.)	2 Minimum Time (min: sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46	230:46
42	39:48	57	41.883 L	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07	314:07
48	45:34	50	54.705 L	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17	410:17
54	51:02	44	69.236 L	115:24	173:05	230:47	288:29	346:11	403:53	461:34	519:16	519:16
60	56:40	40	85.476 L	142:28	213:41	284:55	356:09	427:23	498:37	569:50	641:04	641:04

Note: If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test complete. (See Section 7.5.)

TABLE II

**MINIMUM SPECIFIED TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015**

1 Pipe Diameter (in.)	2 Minimum Time (min: sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23
42	19:54	57	20.942 L	34:54	52:21	69:49	87:15	104:42	122:10	139:37	157:04
48	22:47	50	27.352 L	45:35	68:23	91:11	113:58	136:46	159:33	182:21	205:09
54	25:31	44	34.618 L	57:42	86:33	115:24	144:15	173:05	201:56	230:47	259:38
60	28:20	40	42.738 L	71:14	106:51	142:28	178:05	213:41	249:18	284:55	320:32

Note: If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test complete. (See Section 7.5.)

- C.** Securely brace plugs used to close sewer pipe for the air test to prevent the unintentional release of a plug which can become a high velocity projectile. Locate gauges, air piping manifolds, and calves at the top of the ground. Do not allow any person to enter a manhole where a plugged pipe is under pressure.
- D.** Repair all joints that fail air leak tests. Retest joints that have been repaired.
- E.** If no separate item for sewer line testing is included in the Bid Schedule, include the cost of low-pressure air testing in the price of the item of which it is part.

3.8 TV CAMERA INSPECTION

- A.** TV camera inspection shall be performed on all sewer pipe installed before acceptance. As required by the AHJ.

3.9 FLEXIBLE PIPE DEFLECTION TESTING

- A.** Deflection test shall be performed on all flexible pipes. For pipelines with inside diameters less than 27 inches, a rigid mandrel shall be used to measure deflection. For pipelines 27 inches and larger inside diameter, a method pre-approved by the Engineer shall be used to test for vertical deflections. Other methods shall provide a precision of two tenths of one percent (0.2%) deflection. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of 5.0%. If a pipe should fail to pass the deflection test, the problem shall be corrected and a second test shall be conducted after the final backfill has been in place an additional 30 days. The tests shall be performed without mechanical pulling devices.
- B.** The rigid mandrel shall have an outside diameter (O.D.) equal to 95% of the inside diameter of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average of the inside diameter for I.D. controlled pipe. All dimensions shall be appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.
- C.** The rigid mandrel shall be constructed of a metal or rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. A proving ring shall be provided and used for each size mandrel in use.
- D.** Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test. A deflectometer may be approved for use on a case by case basis. Mandrels with

removable legs or runners may be accepted on a case by case basis. Mechanical devices will not be used to pull the mandrel.

3.9 RESTESTS

- A. Sewer structures which fail to meet the testing requirements shall be repaired and retested by the contractor. All repairs and retesting shall be performed at the expense of the contractor.

3.10 CLEANUP

- A. General: Cleanup ground surface along route of sewer lines and round manholes immediately following completion of backfilling operations. Restore to original condition terrain features in all areas disturbed or damaged by the work.
- B. Smoothly grade ground surfaces disturbed by the work, leaving tops of trenches not under pavement replacement areas slightly mounded to allow for settlement. Remove and dispose of all excess excavated materials including rocks large than 1-1/2 inch size, trash, and unused materials. In turfed areas normally maintained by mowing, rake surface clean, spread and stockpiled top soil and organic matter, and re-seed or re-sod as necessary to restore the surface to the condition of adjacent mowed areas not disturbed by the work.
- C. If no separate item for sewer line cleanup is included in the Bid Schedule, include the cost of cleanup work in the price of the item of which it is part.

END OF SECTION

SECTION 33 39 00

SANITARY UTILITY SEWERAGE STRUCTURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Providing Sanitary Sewer Manholes.

1.2 RELATED WORK

- A. Section 32 05 23 – Cement & Concrete for Exterior Improvements
- B. Section 33 05 16 - Manhole & Structures
- C. Section 33 31 00 - Sanitary Utility Sewerage Piping

1.3 SUBMITTALS

- A. See Related Work

1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM).
 - 1. ASTM A48 Specifications for Gray Iron Castings.
 - 2. ASTM C478 Specifications for Precast Reinforced Concrete Manhole Sections.

PART 2 - PRODUCTS

2.1 MANHOLE MATERIALS

- A. GENERAL: Refer to Standard Detail Drawings.
- B. Precast Concrete Manholes:
 - 1. Manufacture in accordance with ASTM C-478, except that lift holes shall be cast completely through the two walls of each section for the purpose of handling and laying.
 - 2. Concrete strength: 4,500 psi.
 - 3. Reinforcing: Steel mesh of wires not less than 0.17-inch diameter.
 - 4. Riser and grade rings shall be in one-foot increments up to four feet in length.
 - 5. Cone section shall be eccentric except that manholes four feet or less shall have flat slab tops.

6. Construct precast manholes with one-foot section of pipe immediately below cone or top section.
7. Cutouts in bottom sections shall be appropriate for pipe being laid and shall have identifying markings to facilitate their used in correct locations.
8. Furnish natural or artificial rubber gaskets for joints below water table.
9. Manhole steps may be precast in manhole, sides of holes may be left for field grouting in place.
10. Concrete for base: refer to Section 32 05 23 Cement & Concrete for Exterior Improvements.

C. Poured-in place manholes:

1. Refer to Section 32 05 23 Cement and Concrete for exterior improvement.
2. Concrete strength: 3,500psi.
3. Forms shall have cutouts to fit around sewer pipes so that forms rest upon concrete base.
4. Cone or top section shall be concentric.

D. Manhole Rings and Covers: ASTM A48.

1. Weight: Not less than 250 lbs combined.
2. Inside diameter: 24 inches.
3. Height: 5 inches, minimum.
4. Cover shall have removal slot and pin cast into it.
5. Words: "Sanitary Sewer" Shall be cast in top surface cover.

2.2 CONCRETE MORTAR

- A. Mix one part Portland cement with four parts sand and add minimum quantity of water as necessary to provide workable mortar.

2.3 BEDDING AND BACKFILL MATERIALS

- A. Class I Bedding Material: Angular, graded stone, 1/4 inch to 1 1/2 inch size.

PART 3 - EXECUTION

3.1 EXCAVATION GENERAL

- A. Excavate to line and grade shown on drawings or as established on the site.
- B. When excavation is carried below that required or authorized by Engineer, fill space with concrete, or gravel drainage fill, or compacted select material.
- C. Provide sheeting and shoring where necessary to protect workmen, the work, or adjacent property.
 - 1. Leave shoring in place until backfill has proceeded to point where it can be safely removed.
- D. De-water excavations before undertaking and construction therein. Place concrete only upon dry, firm foundation material.

3.2 EXCAVATION

- A. Excavate for base of manholes only to that necessary to provide base of minimum required depth with sides poured against undisturbed earth. If soil foundation below base is mucky, or too soft to properly support the manhole, excavate to a minimum depth of 6 inches below designated soil foundation elevation and refill with drainage fill material.
- B. Excavate above base to provide minimum 24-inch space between outer surface of manhole and embankment or shoring.

3.3 INSTALLATION

- A. General:
 - 1. Refer to Section 32 05 23 Cement & Concrete for Exterior Improvements.
 - 2. Refer to Standard Detail Drawings.
- B. Pre-Cast Manholes:
 - 1. Place concrete base allowing for construction of invert.
 - 2. Position pre-cast sections carefully upon concrete base and raise in truly vertical plane.
 - 3. Fill space between sewer pipe and periphery of cutout with mortar or concrete.
 - 4. Form concrete collar approximately 8 inches wide around pipe against outside of manhole.
 - 5. Construct all pre-cast manholes with one-foot section immediately below cone or top section in order to lower manhole for any future change in grade.

6. Set manhole ring and cover in brick and mortar to required grade and provide concrete cap on outside perimeter.
7. Install natural or artificial rubber gaskets for joints below water table.
8. Make other joints watertight using cement grout or other approved method.

C. Poured-in-place manholes:

1. Place concrete base, allowing for construction of invert; or place base and manhole monolithically.
2. If manhole is poured separately from base, fill cutouts around pipe with concrete.
3. Pour concrete in forms in no more than 18-inch lifts with each layer being vibrated to achieve good bond with prior layer.
4. Set manhole ring and cover and concrete cap as required for pre-cast manholes.

D. Manhole inverts:

1. Extend pipelines entirely through manhole to joints approximately 6 inches outside manhole except where change in direction, in pipe size, or in slope makes such construction unfeasible.
2. Do not extend pipe through manhole in manhole at upper end of line or discharging into an existing manhole.
3. In all cases, extend pipe or pipes through manhole wall one-half the diameter of abutting pipe.
4. Make depth of inverts along line of flow approximately one-half the diameter of abutting pipe.
5. Form curves in inverts with radius as long as feasible to facilitate flow.
6. Shape invert to approximate bottom half of pipe and brush invert surfaces smooth.
7. Slope surface of mortar fill upward from edge of invert to manhole wall.
8. Make upper half of any pipe extending inside manhole wall flush with wall.
9. Smooth rough edges with mortar.
10. Make mortar for forming invert by mixing one part Portland cement and four parts sand and adding minimum quantity of water as necessary to make mortar workable.

3.4 BACKFILL

- A. Allow poured-in-place manholes to cure at least 48 hours before backfilling.

- B. Make initial backfill up to 6 inches above top of sewer line using Class I bedding material, carefully working material under pipe haunches to provide side support to pipes.
- C. Backfill from top of initial backfill to top of manhole or subgrade as specified for backfilling of structures in 33 05 16 Manholes & Structures for the type of compaction requirement applicable.

3.5 TESTING

- A. Manholes should be tested according to the vacuum method of ASTM C-1244 (vacuum method specified below) in the presence of a representative of the Utility. Notify Utility 48 hours before planned time to begin testing. The minimum test times for various manholes diameters from this specification are included below.

1. General:

Plug influent and effluent lines, including service lines, with suitably sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required in this test; follow Manufacturers safety and installation recommendations. Place plugs a minimum of 6 inches outside of manhole walls.

2. Vacuum Test Method

a.) To perform a vacuum test, all lift holes and exterior joints shall be plugged with non-shrink grout and all pipes entering a manhole shall be plugged.

b.) No grout must be placed in horizontal joints before testing.

c.) Stub-outs, manhole boots, and pipe plugs must be secured to prevent movement while a vacuum is drawn.

d.) Contractor shall use a minimum 60 in/lb torque wrench to tighten the external clamps that secure a test cover to the top of a manhole.

e.) A test head must be placed at the inside of the top of a cone section. and the seal inflated in accordance with the manufacturers recommendations.

f.) There must be a vacuum of 10 inches of mercury or 5 psig inside a manhole to perform a valid test.

g.) A test does not begin until after the vacuum pump is off.

h.) A manhole passes the test if after the specified time in Table 1 and with all the valves closed, the vacuum is at least 9.0 inches of mercury or 4.5 psig.

**TABLE 1 Minimum Test Times for Various Manhole Diameters
(30 – 120 in.) in Seconds**

Depth (ft)	Diameter, in.								
	30	33	36	42	48	54	60	66	72
Time, in seconds									
<4	6	7	7	9	10	12	13	15	16
6	9	10	11	13	15	18	20	22	25
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	29	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

**TABLE 1 Minimum Test Times for Various Manhole Diameters
(30 – 120 in.) in Seconds (continued)**

Depth (ft)	Diameter, in.							
	78	84	90	96	102	108	114	120
Time, in seconds								
<4	18	19	21	23	24	25	27	29
6	26	29	31	34	36	38	41	43
8	35	38	41	45	48	51	54	57
10	44	48	52	56	60	63	67	71
12	53	57	62	67	71	76	81	85
14	62	67	72	78	83	89	94	100
16	70	76	83	89	95	101	108	114
18	79	86	93	100	107	114	121	128
20	88	95	103	111	119	126	135	142
22	97	105	114	122	131	139	148	156
24	106	114	124	133	143	152	161	170
26	114	124	134	144	155	164	175	185
28	123	133	145	155	167	177	188	199
30	132	143	155	166	178	189	202	213

3.6 CLEANUP

General: Cleanup ground surface around manholes immediately following completion of backfilling operations. Restore to original condition terrain features in all areas disturbed or damaged by the Work.

END OF SECTION

SECTION 33 40 00
STORM DRAINAGE UTILITIES

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Pipe culverts.
- B. Concrete curb inlet structures and junction boxes.
- C. Connection to existing concrete drainage structures.
- D. Pipe material noted on plans may not be substituted by any other material.

1.2 RELATED WORK

- A. Section 31 20 00 – Earth Moving
- B. Section 32 05 23 – Cement and Concrete for Exterior Improvements.
- C. Section 32 16 13 – Concrete Curb and Gutters.
- D. Section 33 05 16 – Manhole and Structures.

1.3 SUBMITTALS

- A. See Related Work

PART 2 PRODUCTS

2.1 PIPE CULVERTS

- A. Reinforced Concrete Pipe (RCP): ASTM C76-78, Class III.
 - 1. Material: Concrete and reinforcing steel.
 - 2. Shape: Circular.
 - 3. Sizes: As shown on Drawings.
- B. Joint Material:
 - 1. Cold-applied preformed plastic gasket type sealant conforming to Federal Specification SS-5-00210.
 - 2. Primer: As specified by the manufacturer.

C. Polymer Coated Corrugated smooth interior Steel Pipe (CMP): AASHTO M36 and AASHTO M218:

1. Material: Steel (polymeric pre-coated galvanized type B 10mil both sides).
2. Type: Corrugated w / 3/4" x 3/4" x 7 1/2 " external ribs in accordance w/ ASTM A760.
3. Sizes: As shown on Drawings.

D. Corrugated Polyethylene Pipe (CPEP): AASHTO M 294 or ASTM F 2648 for LEED Projects.

1. Material: Virgin Polyethylene compounds, uniformly pigmented, with no cracks or creases. The pipe shall have a minimum pipe stiffness at five percent deflection as follows when tested in accordance with M 294 or F 2648:

<u>Diameter (in)</u>	<u>Pipe Stiffness (psi)</u>
12	45
15	42
18	40
24	34
30	28
36	22

2. Type: "S" – Full circular cross-section with an outer corrugated wall and a smooth inner wall.
3. Sizes: As shown on drawings.

E. Couplings for CPEP

1. Couplings shall be corrugated to match the pipe corrugations and shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation at the joints. Couplings shall be bell and spigot, split collar, or screw-on collar.

2.2 PIPE AND VALVES FOR FUEL CONTAINMENT

A. Pipe used for fuel containment when shown on plan:

1. Ductile Iron Pipe.

B. Valves for fuel containment when shown on plan:

1. See Section 33 12 19

- a. shall contain “Buna N” NBR (nitrile butyl rubber)

2.3 CURB INLET STRUCTURE AND JUNCTION BOX

A. Concrete and reinforcing steel:

- 1. Refer to Standard Detail.
- 2. Refer to Section 32 05 23 and ACI 301.

B. Manhole rings and covers: ASTM A48, Class 30A, Type II Traffic safe.

- 1. Material: Cast Iron, solid cover.
- 2. Size 24-inch diameter with ring depth equal to concrete thickness.

2.4 BEDDING AND BACKFILL MATERIALS

A. Select Backfill Materials: soil excavated from trench or sub-soil from site that is free of rocks larger than 1-1 ½ inches in greatest dimension, and free from frozen soil, large clumps of soil, muddy soil, organic matter and foreign materials.

B. Class I Bedding Material: Angular, graded stone, ¼ inch to 1½ inch size.

PART 3 EXECUTION

3.1 CONCRETE PIPE CULVERT INSTALLATION

- A. Excavate and backfill the trench in accordance with the provision of Section 33 05 16
- B. Grade the bottom of the trench to provide a firm bedding surface of uniform density along the entire length of the pipe.
- C. Shape the bottom of the trench to conform to the bottom one quarter of the outside diameter of the circular pipe.
- D. Lay the pipe beginning at the downstream end with the groove end of the pipe placed facing upstream.
- E. Join pipe using specified cold applied preformed plastic joint sealant. Clean the pipe joint surface and prime, if recommended by the manufacture, brush on and allow to dry. Remove protective wrapping from one side of the rope. Lay rope strip side up on the surface of the pipe joint and press the strip firmly to surface of pipe joint end-to-end continuing around the entire circumference of the joint. Remove the remaining protective wrapping and force pipe into connection until material fills the joint space.
- F. To insure an even and well-filled joint, accomplish the final joining of the pipe by either pushing or pulling by mechanical means each joint of the pipe as it is laid.

- G. In cold weather, either warm the joint material in a hot water bath, or by other approved methods, to the extent required to keep the material pliable for placement without breaking or cracking, or use butyl rubber type joint sealant.
- H. In areas not under pavement of structure "Slice-in" the bedding material under the haunches of the pipe with and then hand tamp or mechanical tamp the backfill up to the horizontal centerline of the pipe.
- I. Under pavement and structures, compact the backfill on the sides of the pipe to the required densities specified in Section 31 20 00 using mechanical tamps with the top 12 inches of subgrade compacted to 95% of the soils Modified Proctor maximum dry density at or near the optimum moisture content.

3.2 CORRUGATED POLYETHYLENE PIPE CULVERT INSTALLATION

- A. Excavate subsoil to depth and grade line as required for proper installation of the culvert pipe. Keep trench as narrow as possible but sufficiently wide to permit tamping under the haunches and installation of connecting band when sections are joined. Keep sidewalls as vertical as possible, at least to an elevation above the top of the pipe.
- B. Grade bottom of trench to provide a firm bedding surface of uniform density along the entire length of the pipe. Remove rock or soft, unstable material encountered at the excavated grade line to a minimum depth of 6 inches and replace with Class I bedding material.
- C. Shape bottom of trench to conform to bottom one quarter of the outside diameter of the circular pipe and up to the widest part of arch pipe, allowing a uniform blanket of loose material to cover the shaped bedding to a depth sufficient to allow the corrugations to be filled with the material.
- D. Place corrugated metal pipe on bedding with longitudinal laps or seems, if any, at the sides. To assemble sections of pipe, place corrugated connecting band around or under the first pipe, then lay the second pipe section with the corrugations matching and the adjacent ends butting together. Keep dirt and gravel out of joint so that corrugations fit snugly. Fasten bolts on band tightly and uniformly.
- E. Place backfill material in 4 inch layer haunches alternately on both sides of pipe, using Class I bedding material. Slice-in with a shovel under the haunches to eliminate voids. Using select backfill material, place material in 6 inch lifts alternately on each side of pipe up to widest part at arch pipe, and using hand tamps or mechanical tampers, compact each lift to a minimum of 90% of optimum density for the material as determined by Modified Proctor procedures, ASTM D-1557. If Class I bedding material is used, place the material in such manner as to eliminate voids and consolidate and interlock the material to form a stable side support for the pipe.
- F. In locations not in traffic areas, hand place select backfill to a level 12 inches above the top of the pipe in such manner as to minimize voids. Backfill up to surrounding ground surface or finished subgrade with subsoil containing no rocks or boulders larger than 6 inches in greatest dimension within 12 inches of the subgrade. Leave top of backfill slightly mounded to allow for settlement.

- G. Under traffic areas, backfill trench from horizontal centerline of pipe up to top of subgrade using either select backfill material or Class I bedding material. If select backfill material is used, place material in 6 inch lifts and compact with mechanical tamps. Compact each layer to within 24 inches of subgrade to 90% of optimum density for the material as determined by Modified Proctor procedures, ASTM D-1557. Compact the remaining 24 inches to subgrade to 95% of optimum density using the same procedures. If Class I bedding material is used, place the material in such manner as to minimize voids and interlock the material to form a stable fill that will support the pavement structure and subsequent traffic loads.
- H. Patch cut edges and surface-damaged areas with specified patching material to restore protection to metal surface originally provided by polymer coating.

3.3 CONCRETE STRUCTURES INSTALLATION

- A. Forming concrete, placing reinforcing steel and placing and curing concrete: Refer to Section 32 05 23 and ACI 301.
- B. Excavation and Backfill: Refer to Section 33 05 16.

3.4 EXISTING STRUCTURE MODIFICATION

- A. Remove top and throat of existing curb inlet.
- B. Remove loose and damaged concrete material.
- C. Dispose of removed material including cast iron ring and cover.
- D. Cut and tie reinforcing steel to new steel as detailed on Drawings.
- E. Form new top and provide new cast iron ring and cover.
- F. Place steel as detailed on Drawings and place concrete to modify structure into a junction box.
- G. Patch inside face of wall to achieve smooth surface.

END OF SECTION