

**SECTION 27 32 41
TWO-WAY RADIO EQUIPMENT AND SYSTEMS**

SPEC WRITER NOTES:

1. Edit between //-----// Delete if not applicable to project. Defer to VA TVE (0050P3B - see Paragraph 1.3.D for specific contact info) for technical assistance.
2. Included throughout this specification are references to the system's interface capability and various related features. The system designer shall verify availability of this system and coordinate associated requirements and subsequent interface(s).

PART 1 - GENERAL

1.1 SECTION SUMMARY

- A. Work covered by this document includes design, engineering, labor, material, products, warranty, training and services for, and incidental to, the complete installation of new and fully operating National Fire Protection Association (NFPA) Listed Emergency 2-way radio equipment 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, CONTROL, COMMUNICATION AND SIGNAL WIRING
- 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 15 00, PUBLIC ADDRESS AND MASS NOTIFICATION EQUIPMENT AND SYSTEMS //

1.3 DEFINITIONS

- A. Provide: Design, engineer, furnish, install, connect complete, test, certify and warranty.
- 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 & security, codes, frequency licensing, standards, guidelines compliance
Office of Telecommunications
Special Communications Team (0050P2B)
1335 East West Highway - 3rd Floor
Silver Spring, Maryland 20910
(O) 301-734-0350, (F) 301-734-0360

E. Engineer: //XXXXXXXX//
//XXXXXXXX//
//XXXXXXXX//
//XXXXXXXX//
//XXXXXXXX//

F. Owner: //XXXXXXXX//

G. General Contractor (GC): //XXXXXXXX//

H. Contractor: Radio Contractor; you; successful bidder.

1.4 REFERENCES

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

1. United States Federal Law / Codes:

a. Departments of:

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

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

(FIPS) 140-2—Security Requirements for Cryptographic Modules.

- b) Chapter XXIII, National Telecommunications and Information Administration (NTIA - aka 'Red Book') Chapter 7.8 / 9 Federal communications Commission (FCC) Title 47 (CFR), Part 15, Radio Frequency Restriction of Use and Compliance in "Safety of Life" Functions & 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) Underwriters 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 & 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 & 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 73	Radio Broadcast Service,
Part 90	Rules 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 & 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@2008IEEE	Medical Grade - Mission Critical - Wireless Networks.
C62.41	Surge Voltages in Low-Voltage AC Power Circuits.

- d. American Society of Mechanical Engineers (ASME):

- 1) Standard 17.4 - Guide for Emergency Personnel.
- 2) Standard 17.5 - Elevator & Escalator Equipment (prohibition of installing non-elevator equipment in Elevator Equipment Room / Mechanical Penthouse).

- e. NFPA:

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

3. State Hospital Code(s).

4. Local Codes.

1.5 QUALIFICATIONS

- A. The OEM shall have had experience with 3 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.

1.6 CODES AND PERMITS

- A. Provide all necessary permits and schedule all inspections as identified in the contract's milestone chart, so that the system is proof of performance tested and ready for operation on a date directed by the Owner.
- B. The contractor is responsible to adhere to all codes described herein and associated contractual, state and local codes.

1.7 SCHEDULING

- A. After the award of contract, the Contractor shall prepare a detailed schedule (aka milestone chart) using "Microsoft Project" software or equivalent. The Contractor Project Schedule (CPS) shall indicate detailed activities for the projected life of the project. The CPS shall consist of detailed activities and their restraining relationships. It will also detail manpower usage throughout the project.
- B. It is the responsibility of the Contractor to coordinate all work with the other trades for scheduling, rough-in, and finishing all work specified. The owner will not be liable for any additional costs due to missed dates or poor coordination of the supplying contractor with other trades.

1.8 REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS

- A. Submit at one time within 10 days of contract awarding, drawings and product data on all proposed equipment and system. Check for compliance with contract documents and certify compliance with Contractor's "APPROVED" stamp and signature.
- B. Support all submittals with descriptive materials, i.e., catalog sheets, product data sheets, diagrams, and charts published by the manufacturer. These materials shall show conformance to specification and drawing requirements.
- C. Where multiple products are listed on a single cut-sheet, circle or highlight the one that you propose to use. Provide a complete and through equipment list of equipment expected to be installed in the system, with spares, as a part of the submittal. Special Communications (TVE-0050P3B - herein after referred to as [0050P3B]) 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 & D, at a minimum for compliance review as described herein where each responsible

individual(s) shall respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).

- 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 speaker.
- H. Antenna Farm Pictorial: Antenna(s), mast(s) and mount(s) pictorials as they are planned to be installed.
- I. 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 RE.
 - 4. The Contractor shall fully qualify the outside coverage requirement by a geographic map, with the Facility in its center and outline all coverage locations, radiating in a 360 degree pattern, as to primary, secondary, marginal, and out of range operation. The Contractor shall fully document the systems outside coverage requirement for each operating frequency as follows:
 - a. Within the Facility structure for:
 - 1) Radio Paging
 - 2) Security Service
 - 3) Engineering Service
 - 4) MAS
 - b. Within the Facility's immediate grounds for:
 - 1) Radio Paging
 - 2) Security Service
 - 3) Engineering Service

- 4) MAS
- c. A 40 km minimum radius from the Facility for radio paging:
- d. //Travel routes _____, _____, and _____ for:
 - 1) Radio Paging
 - 2) Security Service
 - 3) _____//
- 5. 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.

1.9 PROJECT RECORD DOCUMENTS (AS BUILTS)

- A. Throughout progress of the Work, maintain an accurate record of changes in Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.
- B. The floor plans shall be marked in pen to include the following:
 - 1. All device locations with labels.
 - 2. Conduit locations.
 - 3. Head-end equipment and specific location.
 - 4. Wiring diagram.
 - 5. Labeling and administration documentation.
 - 6. Warranty certificate.
 - 7. System test results.

1.10 WARRANTIES

- A. The Contractor shall warrant the installation to be free from defect in material and workmanship for a period of 2 years from the date of acceptance of the project by the owner. The Contractor shall agree to remedy covered defects within 4 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 Warranty requirements.

1.11 USE OF THE SITE

- A. Use of the site shall be at the GC's direction.
- B. Coordinate with the GC for lay-down areas for product storage and administration areas.
- C. Coordinate work with the GC and their sub-contractors.
- D. Access to buildings wherein the work is performed shall be directed by the GC.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.
- B. Store products in original containers.
- C. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.
- D. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the Owner.

1.13 PROJECT CLOSE-OUT

- A. Prior to final inspection and acceptance of the work, remove all debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from the project site and thoroughly clean your work area.
- B. Before the project closeout date, the Contractor shall submit:
 - 1. Warranty certificate.
 - 2. Evidence of compliance with requirements of governing authorities such as the Low Voltage Certificate of Inspection.
 - 3. Project record documents.
 - 4. Instruction manuals and software that is a part of the system.
- C. Contractor shall submit written notice that:
 - 1. Contract Documents have been reviewed.
 - 2. Project has been inspected for compliance with contract.
 - 3. Work has been completed in accordance with the contract

PART 2 - PRODUCTS / FUNCTIONAL REQUIREMENTS**2.1 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS**

- A. Furnish and install a complete and fully operational two way radio repeater system. Include all amplifiers, power supplies, cables, outlets, attenuators, antennas, towers and other parts necessary for the reception, transmission and distribution of the off-the-air VA licensed or approved radio 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 // - --- // percent above those indicated without adding any internal or external components or main antenna or trunk cable conductors.

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

2.2 SYSTEM DESCRIPTION

- A. The Contractor is responsible for interfacing the telephone //, and _____ // systems with the system.
- B. The two-way radio system is defined as Emergency Service by NFPA (re Part 1.1.A) and so evaluated by JCAHCO.
- C. 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 also a matching of signal, voltage, and processing levels with regard to signal quality and impedance. The interface point must adhere to all standards described herein for the full separation of Critical Care and Life Safety systems.
- D. It is not acceptable to utilize the telephone cable system for the control of radio signals and equipment. The System Contractor shall connect the Telephone System Remote Control System to the Radio System Paging Control Unit ensuring that all NFPA and Underwriters Laboratory, Inc. (UL) Critical Care and Life Safety Circuit and System separation guidelines are satisfied. The System Contractor is not allowed to make any connections to the Telephone System. The Owner shall arrange for the interconnection between the Two-Way Radio and Telephone Systems with the appropriate responsible parties.
- E. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications and be provided with screw type audio connectors.
- F. 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.
- G. 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.

- H. The system shall provide continuous electrical supervision of each RF amplifier, interconnecting trunk and riser cables and UPS to determine change of status and to assist in trouble shooting faults.
- I. Provide a backup battery or a UPS for the system to allow normal operation and function (as if there was no AC power failure) in the event of an AC power failure or during input power fluctuations for a minimum of 30 minutes.
- J. 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.
- K. All equipment faceplates utilized in the system shall be stainless steel, anodized aluminum or UL approved cycolac plastic for the areas where provided.
- L. Noise filters and surge protectors shall be provided for each equipment interface cabinet, head-end cabinet, control console and local and remote amplifier locations to insure protection from input primary AC power surges and to insure noise glitches are not induced into low voltage data circuits.
- M. Audio Level Processing: The control equipment shall consist of audio mixer(s), volume limiter(s) and/or compressor(s), and power amplifier(s) to process, adjust, equalize, isolate, filter, and amplify each audio channel for each sub-zone in the system and distribute them into the system's RF interfacing distribution trunks and amplification circuits. It is unacceptable to use identified Telephone System cable pairs designated for Two-Way Radio interface and control use or identified as spare telephone cable pairs by the Facility's Telephone System Contractor. The use of telephone cable to distribute RF 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 each speaker identified on the contract drawings.

- N. 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, and
 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. Control Console: A console shall be provided in the Police Operations Room, Disaster Control Room, Service, Engineering Service, MAS // and _____ location(s) // and as shown on the drawings. The console shall contain visual enunciators for each control function that visually display the system function used and/or in use by microphone(s) and telephone(s).
- B. Local radio paging consoles and/or remote control units shall be provided in the following locations and/or other designated 24 hour a

day facility operational area for facility wide only code one (blue) paging function and as shown on the drawings:

1. Telephone Operator.
 2. Security Service Command Console.
 3. // _____ . //
- C. Local radio paging consoles and/or remote control units shall be provided in the following locations area for Facility wide routine two-way radio and radio paging functions and as shown on the drawings:
1. Telephone Operator.
 2. Security Service Command Console.
 3. Engineering Service.
 4. MAS.
 5. // _____ . //
- D. Each floor and/or office control and interface system shall be provided in a "buss" design where each location's and/or floor's radio control console and/or control equipment is fed from centrally located (usually in the corridor) lateral trunk-line cables. Each signal closet shall contain a minimum of one terminal cabinet capable of connection to vertical trunk-line riser cables to lateral trunk-line cables in the associated signal closet and as shown on the drawings or recommended by the OEM.
- E. Head-end Cabinet Location: The head-end equipment shall be provided, protected, and located in a cabinet adjacent to the // _____ equipment in the _____ Room // // other _____ // as close as possible to the antenna location and as shown on the drawings. The cabinet shall be provided and protected at this location to insure optimum origination, reception, and control of all system signals. Each cabinet shall be provided with an internal active 120 Volts Alternating Current (VAC) quad receptacle connected by conduit to the Facility's Critical Branch Emergency Power distribution panel designated by the Resident Engineer. Each cabinet shall be provided with a minimum of two feet or clearance from all obstructions in the signal closet where located. Each cabinet shall be provided as required to meet the single audio channel requirements and system performance standards.
- F. Interface Cabinet Location: Provide the cabinet in // _____ // and as shown on the drawings. Connect 120 VAC quad receptacles to the Facility's Critical Branch Emergency Power AC distribution panel as designated by the RE.

G. Operator Control Console Location: Provide the cabinet in // _____
 // and as shown on the drawings. Connect 120 VAC quad receptacles to
 the Facility's Critical Branch Emergency Power AC distribution panel as
 designated by the RE.

H. Antenna Equipment:

1. Guyed and Free Standing Towers:

Guyed: The Contractor shall forward two copies of the report to
 Owner for technical review.

2. Ground Type Installations:

The antenna site shall be protected from accidental intrusion by
 station personnel or patients. The ground protection design shall be
 sufficient in scope to secure the entire antenna area by a chain
 link fence and gate with lock and key. Wood fences are not
 acceptable.

3. Technical Characteristics:

Radio Frequency Interference (RFI)	None measurable
Construction	3 meters (10 foot) high, rust proof with 1.2 meters (4 foot) wide gate
Securing	Lock with two sets of keys for the gate

I. Nitrogen Tank: Nitrogen tank(s) shall be secured, pressurized and full.
 All required valves, transmission line connections and gauges shall be
 furnished and properly installed. The tank(s) shall be 6.3 m² (226 Cubic
 Foot) "K" size, with a charge of 998 kg per cm² (2,200 pounds per square
 inch). A protective cover or enclosure shall be furnished and installed
 by the Contractor to secure all valves and controls. Provide one spare
 full tank.

J. RF Transmission Line:

1. Spiral: The provided transmission line shall be coaxial, jacketed
 with fire resistant material when run outside of conduit and/or
 cable tray, or as required by system design, and pressurized to the
 OEM's specifications.

a. The cable shall be as specified by the OEM. If not specified by
 the OEM, it shall be provided with the proper impedance, be
 double shielded, and contain other characteristics to satisfy all

equipment and system requirements. The cable shall meet the following specifications

b. Technical Characteristics:

Outside Diameter	13 mm (0.5 inch), maximum
Center Conductor	Solid Copper, Silver Coated
Insulation	Polyethylene with air passages
Jacket	Teflon or Kynar (when required)

c. Attenuation:

Frequency (MHz)	Attn/dB per 100 ft
100	2.5
200	3.5
400	5.0
890	8.0

2. Feed Through: A feed through shall be provided for all penetrations of exterior building walls or roofs. The feed through(s) shall be waterproof, sleeved, and OEM recommended and Resident Engineer approved for the system.
3. Humidity Protection: At a minimum, the interior of all transmission lines shall be protected from the infiltration of moisture or water as follows:
 - a. Nitrogen Tank: Nitrogen tank(s) shall be secured, pressurized and full. All required valves, transmission line connections and gauges shall be furnished and properly installed. The tank(s) shall be 6.3 m³ (226 cubic foot) "K" size, with a charge of 998 kg per cm² (2,200 pounds per square inch). A protective cover or enclosure shall be furnished and installed by the Contractor to secure all valves and controls. Provide one spare full tank.
 - b. Dry Air: A dry air system is an acceptable alternate for the nitrogen tank. The dry air system shall be specifically designed for the installation and as described, recommended by the OEM, mechanically approved by the RE.
4. Lightning Protection System: Each protection system shall be provided in its entirety totally and externally to the building. The

use of internal electrical grounding systems is not acceptable and will not be approved.

- a. Antenna, Mount, Mast, and Tower: The antenna, antenna mount, tower or mast and transmission line shall be grounded with cooper wire run external to the building and connected to the earth ground. If the antenna is to be installed in an area not protected by lightning rods or if the antenna is to be elevated above existing lighting rod protection, the Contractor shall immediately notify the Resident Engineer in writing regarding the lightning strike hazard.
- b. Radio Frequency Transmission Line and/or Coaxial Cable Lightning Protector:
 - 1) The protector shall be an in-line device equipped with screw type connectors to match the coaxial cable specified. It shall be grounded with stranded copper wire run external to the building and connected to the earth ground. It shall be able to shunt high current surges to the earth ground protecting the system signal receiving equipment. The protector shall have a minimal effect on the quality of the signal being received or transmitted. It shall be made of non-corrosive metal and be waterproof.
 - 2) Technical Characteristics:

Peak Pulse Power	1500 W @ 77° F
Protection Device	Gas Tube or as required by OEM
Dissipation	1.0 Milliseconds (MS)
Response Time	5.0 nS (nano seconds)
Connectors	As Specified
Ground Wire	#6 AWG Stranded Copper, minimum, or as required by the OEM, and/or the RE

K. Head-end Equipment:

1. Equipment Cabinet:

- a. Head-end Cabinet Location: The head-end equipment shall be provided, protected and located in a cabinet adjacent to the // _____ equipment in the _____ Room// // other _____ // as close as possible to the antenna location and as shown on the drawings. The cabinet shall be provided and

protected at this location to insure optimum origination, reception and control of all system signals. Each cabinet shall be provided with a minimum of 610 mm (two feet) or clearance from all obstructions in the signal closet where located. Each cabinet shall be provided as required to meet the single audio channel requirements and system performance standards.

- b. The equipment cabinet shall be lockable, heavy gauge steel (16 gauge minimum), iron phosphate treated prior to finishing, with baked on paint finish in a color selected by the Resident Engineer. 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 Resident Engineer when the system is accepted.
- c. A minimum of 380 mm (15 inches) of blank front rack space for additional equipment shall be provided. Blank panels shall be installed to cover any open or unused rack space. One blank 45 mm (1.75 inch) high, blank panel shall be installed between each item of equipment.
- d. Blank panels shall be color matched to the cabinet, 3.2 mm (1/8 inch) aluminum with vertical dimensions in increments of 45 mm (1.75 inch) with mounting holes spaced to correspond to EIA/TIA 483 mm (19 inch) dimensions. Single standard size blank panels shall be used to fill unused panel or rack spaces in lieu of numerous 45 mm (1.75 inch) types.
- e. AC Power Outlet Strip(s): A strip shall be provided with a grounded outlet for each item of equipment and a minimum of four spare AC power outlets. Each strip shall be permanently (cable ties are not acceptable) mounted inside and at the rear of each equipment cabinet. The strip shall be self-contained in a metal enclosure with a maximum of a 2 meter (6 foot) connecting wire sized No. 14 AWG with three prong AC power plug, all rated 15A at 120V. Extension or "pig tail" non-protected cords from the system cabinet or rack to each system wall outlet is not authorized and shall not be allowed and if discovered shall be grounds to declare the entire system unacceptable and terminate all acceptance testing.

f. AC Power Line Surge Protector and Filter:

- 1) Each cabinet containing active electronic equipment 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 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's AC power strip (two strips maximum) may be connected to it.
- 2) Technical Characteristics:

Input Voltage Range	120 VAC + 15 percent
Power Capacity	15 AMP, 120 VAC
Voltage Output Regulation	+3.0 percent
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 Nano Seconds (ns)
Surge Suppression	10,000 AMPS
Noise Suppression:	
Common	-40 dB
Differential	-45 dB

g. Audio Monitor Panel:

- 1) The panel shall be EIA/TIA standard for 483 mm (19 inch) cabinet mounting. It shall be provided in the upper portion of the head-end equipment cabinet.
- 2) Technical Characteristics:

Monitor Speaker	A permanent magnet, 76 mm (3 inch) minimum diameter, and a monitor volume control
Audio Meter	Easy to read Volume Unit (VU) or similar meter with illuminated scale and meter calibrating control.

Channel Selector Switch	Six positions (Off, 1, 2, 3, 4, and Spare) which shall connect the monitor speaker and VU meter to the selected audio channel.
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h. Trouble Annunciator Panel:

- 1) A trouble annunciator panel shall be provided in the head-end cabinet and Telephone Operator, // and _____// locations and as designated on the contract drawings. The panel shall be compatible with or generate electrical and/or electronic supervising signals to monitor continuously the operating condition for the system head-end audio power amplifier(s), remote power amplifier(s), and interconnecting trunks. The panel shall generate an audible and visual signal when the system's supervising system detects an amplifier or trunk line is malfunctioning. Provide one spare panel.

2) Technical Characteristics:

Silence Button or Switch	Shall silence the audible signal. However, the visual signal will continue until the supervisory circuit indicates the fault is corrected.
Visual Enunciators	Visually show the amplifier and/or trunk-line unit or supervisory circuit is in fault condition.

L. Radio Terminals:

1. General: The radio terminal shall be analog, amplitude (AM) or frequency (FM) modulated, cabinet mounted, and modular constructed. It shall be designed to operate in the specified Government Protected RF Bands and shall conform to Narrow Band Operation. The terminal shall have built-in test points and metering to measure the principle operating functions and power supply voltages without disrupting service. Provide one spare set of modules and power tubes.
2. Radio Paging Terminal: The radio paging terminal shall be redundant, hot standby, provided with UPS, and be fully electrically supervised.

M. Audio Power Amplifier:

1. The amplifier(s) shall have a minimum of two input channels, each with bridge output circuitry and bridge or parallel single channel inputs. Each output shall be capable of providing a 70.7V "constant voltage" audio line. Each output channel shall be selectable between eight Ohms and 70.7V modes. The Amplifier circuit components and load shall be fully protected from input overdrive, mismatching, or shorting failure. Input controls shall be lockable and fixed. Provide one spare amplifier.
2. Technical Characteristics:

Frequency Response	45 to 15,000 Hz + 1.0 dB, minimum
Max Hum and Noise	80 dB Below Rated Output, minimum
Rated Output	Minimum of 125 percent consumed by associated speakers, 35 Watts minimum required
Input for Rated Output	0.8 V for rated output
Total Harmonic Distortion (THD)	0.5 percent maximum rated output.
Output Level	8 Ohms and 70.7V options on the power amplifier
Regulation	Required
Electrical Supervision	Required for each amplifier to report fault indications that include: input AC power failure, PA amplifier output failure, and internal PA amplifier DC power supply failure
"On/OFF" Switch with Pilot Light	Required
Master Gain Control	Required
Input Level Adjustment	Required, for each input
AC Input Circuit Protection	Required, short circuit protected
Extra Cooling	Required, internal variable speed fan

2.5 REMOTE CONTROL EQUIPMENT

- A. Operator Control Console Location: Each console shall be provided, protected and located in the respective service area (i.e. Telephone

Operator, Security, Engineering, MAS, etc.) to insure optimum origination, reception and control of all system signals. Each console shall be provided with an external active 120 VAC quad receptacle. Each console shall be provided with a minimum of 305 mm (one foot) of clearance from all obstructions in the area where located. Each console shall be provided as required to meet the single audio channel requirements and system performance standards.

B. Microphone Paging Console:

1. A console shall be provided in the Telephone Switchboard Room or Telephone Operator //, and _____ // location(s) and as shown on the drawings. The console shall contain visual enunciators for each zone, which shall visually display the system zones in use by microphone(s) and designated telephone(s). Provide one spare console and microphone.

2. Technical Characteristics:

a. Microphone:

ON OFF Switch	Required
Impedance Matching Device	Required, multiple tap type
Impedance	Low (150 Ohms minimum), balanced
Type	Omni-direction, dynamic type
Frequency Range	60 - 10 kHz, minimum
Output Audio Signal Level	-52.0 dB, minimum
Nominal Weight	1.36 kg (3 pounds), minimum

b. Console:

Switches or Push-Buttons	Required, to select any single sub-system and/or all sub-systems simultaneously. Additionally, a separate switch or push-button shall be provided for the ALL CALL function that immediately overrides all paging calls in every zone and sub-zone.
Mounting	Desk top or cabinet
Construction	Metal constructed as described for the head-end cabinet (may be custom designed by the Contractor if approved by the RE)

UPS and/or Battery Backup	Required
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C. Radio Control Console:

1. A console shall be provided in the Security Service Control Room, Engineering Service Room // _____ //, MAS Room // _____ //, and //_____ // location(s) and as shown on the drawings. The console shall contain visual enunciators for each zone, which shall visually display the system zones in use by microphone(s), designated telephone(s), and other radio systems. Provide one spare console and microphone.
2. Technical Characteristics:
 - a. Microphone:

ON OFF Switch	Required
Impedance Matching Device	Required, multiple tap type
Impedance	Low (150 Ohms minimum), balanced
Type	Omni-direction, dynamic, flexible arm type
Frequency Range	60 - 10 kHz, minimum
Output Audio Signal Level	-52.0 dB, minimum
Nominal Weight	1.36 kg (3 pounds), minimum

b. Console:

Switches or Push-Buttons	Required, to select any sub-system and/or all sub-systems simultaneously. Additionally, a separate switch or push-button shall be provided for the ALL CALL function that immediately overrides all paging calls in every sub-system.
Mounting	Desk top or cabinet
Construction	Metal constructed as described for the head-end cabinet (may be custom designed by the Contractor if approved by the RE)
UPS and/or Battery Backup	Required

D. Telephone Paging Adapter:

1. The Facility's Telephone Maintenance Contractor or local telephone company shall be consulted by the Contractor where the Contractor shall provide and install a paging adapter for each zone and sub-zone designed for use with the Facility's telephone system. The adapter(s) shall operate from telephone number access provided by the Facility's Telephone Contractor. Note: This unit may contain the Time Out Device identified in paragraph 2.4.D. Provide one spare set of electronic cards and/or modules.
2. Technical Characteristics:

Frequency Response	200 to 7.0 kHz, minimum
Input Impedance	600 Ohms, balanced or shall match the telephone company lines & VAMC telephone system.
UPS and/or Battery Backup	Required

E. Time Out Device: A time out device shall be provided to prevent system "hang-up" due to an off-hook telephone. The device shall be able to be preset from 30 seconds to two minutes. Its function shall not interfere with or override the required all call operational capability. Note: This device may be combined with the Paging Adapter identified in paragraph 2.4.C.

F. Volume Limiter and/or Compressor:

1. Each unit shall provide a constant input to each audio power amplifier where used in the system. At a minimum, each operable and spare zone shall be equipped with a limiter/compressor installed in the head-end cabinet. The unit shall compensate for the different input volumes to provide a constant level regardless of which audio input source is used. Each audio input and output impedance shall match the telephone and microphone inputs, audio power amplifiers, and any associated equipment. It may be incorporated as a part of the equipment identified in paragraph 2.4.C. Provide one spare limiter and/or compressor.

2. Technical Characteristics:

Frequency response	45 - 15 kHz, + 1.0 dB minimum
Signal Reduction Ratio	10 to 1 and 5 to 1, selectable
Total Harmonic Distortion	<1.0 percent
Output Level	+14.0 dBm, minimum
Inputs	Two minimum, each shall be equipped with a variable front panel gain control and VU or dB meter for adjustment

G. Audio Mixer:

- The mixer shall contain multiple input/preamplifiers providing automatic attenuation of unused or inactive inputs. Adjustable gain reduction shall be from zero to +20 Log Nominal dB (0 - +6dB) at each output doubling of simultaneously active inputs. It may be incorporated as a part of the equipment identified in paragraph 2.4.C. Provide one spare mixer.

2. Technical Characteristics:

Frequency Range	20 Hz -20 kHz, minimum
Distortion	0.1 percent, at 1 kHz test tone
S/N	70 dB with the band pass, input volume minimum and main volume maximum

Inputs:	
Number	Four, minimum, electronically balanced
Impedance	150 - 600 Ohms balanced, selectable
Level	+15.0 dBmV, maximum

Outputs:	
Main:	
Impedance	600 and `150 Ohms, selectable, electronically balanced
Isolation	Transformer provided
Direct:	

Number	One per channel
Impedance	450 - 680 Ohms, balanced

Security Cover	Required, must restrict access to all controls, but allows viewing of various lights or LED's
Signal Indicators	VU analog meter or LED for each input and output
Connectors	"XL" or "Phone Jack"

2.6 WIRELESS

A. Radio Paging Equipment and Systems:

1. The radio paging system shall be a VA Certified and Licensed system (FCC Part 15 listed pagers and transmitters are not allowed for "Safety of Life" functions or installed in those specific areas - VA Headquarters TVE - 0050PB2 and SM - 0050PB2 are the ONLY approving authorities for this function) and must have the following minimum system features:
 - a. Ability to pass-through location information (such as a room number) and call-type as well as other text messages simultaneously to shift supervisor identified staff members
 - b. Ability to allow the operator to select staff members by name and pager number and to select a message consisting of a room number and a condition code (aka priority level). Operator may also choose to type in a unique alpha-numeric text message (the text message shall meet or exceed all HIPA and VA OCIS Communications Security Guidelines for the transmission of Patient or Staff Specific information [aka PII] - VA Headquarters TVE - 0050P2B is the approving authority for this function) into the system to be read by the holder of the pager unit.
 - c. While a patient station is connected to the nurse's master station, the radio paging system shall allow the operator to automatically page a staff member assigned in that area / room. An alternate staff member may be selected for paging purposes in place of the primary staff member. The radio paging system must allow an alternate staff member to be paged when the primary staff member is unable to respond to patient's needs within a specified period of time. The radio paging system must have the

ability to assign any pager or pager group, and to assign an unlimited amount of pagers to any location.

2. The radio paging system shall have the ability to send all code blue calls to staff members by predetermined group (as required or aka 'ALL CALL') automatically by simply pressing one "Code Blue" button. The Code Blue Pager shall indicate room number of code call, and state "Code Blue" in plain English format on pagers (FCC Part 15 listed pagers are not allowed to be use as "Safety of Life" functions or those specific locations - VA Headquarters TVE - 0050P2B is the approving authority for this requirement).

B. Personal Wireless Communicator (PWC):

1. The radio paging system will only be allowed to connect to the personal wireless communications system, pass text data and provide a 2-way communication between the Telephone Interface and the personal wireless communicator as long as it is not a FCC Part 15 listed device(s), meets or exceeds UL 60950-1/2, meets OCIS Guide Lines for FIPS 140-2 certification and the using staff shows an extensive training program along with recertification(s) according to the Facility Emergency Plan concerning HIPA requirements.
2. VA Headquarters TVE - 0050P3B and SM - 0050P2B are the approving authority for this requirement.

C. Other Wireless Equipment and Systems:

1. Each proposed wireless system and/or equipment to be connected to or be a part of the PAS system, each shall meet the minimum requirements outlines in Paragraph 2.7.A.
2. Contact TVE - 0050P3B and SM - 0050P2B for specific required preapprovals (full or conditional) as described herein.

2.7 DISTRIBUTION EQUIPMENT

- A. Audio Power Amplifier: Refer to the amplifier characteristics in paragraph 2.2.C. for each amplifier used in the distribution system. Provide one spare amplifier in addition to the spare head-end amplifier.
- B. RF Distribution and/or Power Amplifier: The amplifier shall perform the necessary RF signal amplification to allow the system to operate within its described performance standards. It shall be mounted within a distribution cabinet and provided with an UPS or battery back up in locations selected by the Contractor and approved by the OEM. Provide one spare amplifier.

C. Distribution System Cabinets: The cabinet shall have the same technical characteristics as the head-end cabinet, and may be wall mounted type with control knobs.

1. Distribution and/or System Interface Cabinet:

- a. The cabinet(s) shall have hinged front and rear (front door only if wall mounted) doors. Each cabinet shall be wall mounted and may be floor mounted per system design and OEM recommendation.
- b. Technical Characteristics:

Overall Height	2181 mm (85 7/8"), maximum
Overall Depth	648 mm (25 1/2"), maximum
Overall Width	535 mm (21 1/16"), maximum
Vertical Mounting Space	1959 mm (77 1/8"), maximum
Front Panel Horizontal Width	484 mm (19 1/16"), EIA horizontal maximum
Hole Spacing	EIA

2. Equipment Breakout or Termination Connector Panel:

- a. The connector panel shall be made of flat smooth 3.2 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.
- b. Technical Characteristics: Product reference or Government Approved (US State Department) manufacturer is Telewire, CATV Division, PUP-17 with F-81D connectors installed. This panel may be used for RF, fiber-optic, video, audio, and control cable installations when provided with the proper connectors. This panel is not allowed to be used for 120 VAC power connections.

Size:	
Height	88.9 mm (3.5"), minimum
Width	484 mm (19 1/16"), EIA minimum
Number of Connections:	12 pairs (or sets), minimum
Connectors:	
RF	"F81D"

Audio	6.35 mm (1/4") Phono, XLR, or RCA (Barrier strips, surface mounted with spade lugs, punch block or wire wrap type strips are acceptable alternates)
Control	Barrier strips surface mounted with spade lugs, punch block or wire wrap type strips
Low Voltage Power (Class II)	Barrier strips with spade lugs and plastic cover, surfaced mounted
Fiber-Optic	"ST" Stainless steel, female
RF	As specified

3. Junction Boxes:

- a. Junction box(s) shall be flush or surface mounted and installed at least 457 mm (18 inch) above a finished floor for main room interconnection or above dropped ceilings anywhere in the system. If the dropped ceiling is rigid, the Contractor shall provide an access door or other approved means in the ceiling to allow easy access to the junction box.
 - b. Junction boxes containing system active electronic equipment shall be additionally provided with quiet fan and non disposable air filter, hinged doors and locks keyed alike with two keys. Universal lock keying of each system enclosure is acceptable. Junction boxes containing system passive equipment are allowed to be provided with an approved tamperproof full size front cover as an alternate to the hinged doors with locks and keys.
 - c. External conduit(s) shall be provided and installed by the Contractor between each junction box and enclosure to allow interconnection and protection of all signal, control and power wires or cables.
- D. System Cables: Each cable shall meet or exceed the specifications listed below for each identified cable. Additionally, the Contractor shall provide a 610 mm (2 foot) sample of each CFE provided cable and OEM cable 100 percent sweep certification tags from each cable reel to the Resident Engineer and receive approval in writing before installation. Each cable shall have a Temperature Rating of +80 degrees Centigrade(C) (+176? F). Provide all partially used reels of system reels of cable to the Resident Engineer to be counted as spare units.

1. Radio:

a. RG-214/U and/or RG-8/U Type:

- 1) The cable between radio equipment in the head-end and major distribution trunk lines shall be coaxial double shield type.

The cable shall meet the following specifications:

2) Technical Characteristics:

□ Impedance	52 Ohm
Center Conductor	14 AWG Solid Copper or Copper Clad
Dielectric	Polyethylene
Jacket	Polyethylene (Teflon or Kynar as required)

3) Attenuation:

Frequency (MHz)	Attn./dB per 100 ft
7	0.31
54	1.10
216	2.40
470	3.8
890	5.6

b. RG-58/U:

- 1) The cable shall be double shielded coaxial type. The cable shall meet the following specifications:

2) Technical Characteristics:

□ Impedance	52 Ohm
Center Conductor	20 AWG Solid Copper or Copper Clad
Shields	Two
Dielectric	Foam
Jacket	Polyethylene (Teflon or Kynar as required)

3) Attenuation:

Frequency (MHz)	Attn./dB per 100 ft
7	0.6
54	1.8

216	3.5
470	4.7
890	7.0

c. Audio:

1) Microphone or Line Level:

a) Audio cable shall be two conductors, shielded cable with stranded conductors and polyethylene insulated.

b) Technical Characteristics:

Wire Size	20 AWG
Working Shield	350 V
Shield Coverage	100 percent
No of Pairs	At least two individually shielded with separate ground drain wire
Jacket	Polyethylene (Teflon or Kynar as recommended by the OEM and approved by VA

2) Loudspeaker:

a) Audio cable shall be two conductors with stranded conductors and polyethylene insulated. The cable shall be able to handle the power and voltage used for the load impedance over the distance(s) required, with not more than 5 percent power loss.

b) Technical Characteristics:

Wire Size	16 AWG
Working Voltage	350 V
Shield	As required, with separate drain wire
No of Pairs	At least two
Jacket	Polyethylene (Teflon or Kynar as recommended by the OEM and approved by VA

3) Voice and Control: Voice and control cable shall be as specified by the radio OEM. If it is not specified by the

equipment OEM, it shall be at least 20 gauge solid or stranded copper wire with aluminum foil individually shielded pairs. Its jacket shall be polyethylene (or Teflon or Kynar) as recommended by the OEM and approved by VA.

E. System Connectors:

1. General: Each connector shall be designed for the specific size and type of cable being used and be installed with the OEM's approved installation tool. Typical system cable connectors include, but, are not limited to: UHF, N, F, BNC, KS, XL(R), RCA, Phono Plug, and Forked Connectors (or Audio Spade Lug type) with Barrier Strips. Provide all partially opened boxed of system connectors to the Resident Engineer to be counted as spare units.
2. RF Types: These connectors shall be connected to provide the following polarity: Center wire --Signal or positive (+); First Shield -- Common or neutral; and Second shield (if provided) -- Ground or return:

a. "UHF":

- 1) The connector shall have screw type coupling for quick connect and disconnect of coaxial cable terminations. It shall be a crimp-on connector designed to fit the coaxial cable furnished.
- 2) Technical Characteristics:

Impedance	52 Ohms
Working Voltage	500 V

b. "N" Type:

- 1) The connector shall have screw type coupling for quick connect and disconnect of coaxial cable terminations. It shall be a connector designed to fit the coaxial cable furnished.
- 2) Technical Characteristics:

Impedance	50 Ohms
Working Voltage	500 V

c. "BNC" Type:

- 1) The connector shall have a bayonet locking coupling for quick connect and disconnect of coaxial cable terminations. It shall

be a crimp-on connector designed to fit the coaxial cable furnished.

2) Technical Characteristics:

Impedance	52 Ohms
Working Voltage	500 V

3. Audio:

- a. General: Each connector shall be installed according to the cable or connector OEM's instructions and use the OEM's approved installation tool. Use the slogan "George Washington Bridge" in determining audio signal polarity. George is the "ground or return" wire; Washington is the "white or signal neutral" wire and Bridge is the "black or signal positive" wire, throughout the system using three conductor type wires. Install the connector's to provide and maintain the following audio signal polarity: XLR type connectors -- Signal or positive conductor is pin 3, common or neutral conductor is pin 2, green, ground or return conductor is pin 1; 6.35 mm (1/4 inch) or 3.2 mm (1/8 inch) Phono Plug and Jacks -- signal or positive conductor is TIP, Common or neutral conductor is RING, Shield, ground, or return conductor is SLEEVE; RCA Phono Plugs and Jacks -- signal or positive conductor is TIP, and shield, neutral or common conductor is SLEEVE.
 - b. Microphone Input "XLR": Female configuration with three pins.
 - c. Microphone Output "A3M": Male configuration with three pins.
 - d. Line Level Input: Female "XLR" type with 3 pins or 6.35 mm (1/4 inch) phone receptacles provided with standard mounting plates.
 - e. Line Level Output: Male "A3M" type with 3 pins or 6.35 mm (1/4 inch) phone plug secured to the audio cable.
4. Speaker Line Audio:
- a. Each connector shall be provided according to the cable, transformer or speaker OEM instructions and use the OEM's approved installation tool. Each speaker line shall be permanently connected to each appropriate speaker or line matching transformer connection terminal. Speaker line connection to each audio amplifier shall use audio spade lugs as described herein. The Contractor shall ensure each speaker is properly

"phased" and connected in the same manner throughout the system using two conductor type wires.

b. Technical Characteristics:

Terminal Size	6-32, minimum
Wire Size	20 AWG, minimum
Color Code	One of the conductors shall be to aid in establishing speaker signal polarity
Signal Polarity:	
Color Coded Wire	Signal or positive
Non-color Coded Wire	Common or neutral
Shield (if provided)	Ground or return

5. Wire:

a. AC wiring shall conform to the following polarity:

- 1) Black wire: Hot or positive
- 2) White wire: Neutral or common
- 3) Green wire: Earth ground

6. Terminal Strips and Wiring Blocks: Provide all partially opened boxes of terminal strips or blocks to the Resident Engineer to be counted as spare units.

a. Barrier Strips:

- 1) Barrier strips are required for AC power, data, voice and control cable or wires. Barrier strips shall accommodate the size and type of audio spade (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 Amount	Any combination
Wire Size	20 AWG, minimum

Voltage rating	100V, minimum
Protective Connector Cover	Required for Class II and 120 VAC power connections

- b. Wiring Blocks: Industry Standard Type 110 Category 5 Rated wiring blocks, are approved for data, voice and control wiring. Wiring blocks shall be specifically designed for the size and type of wire used. Designation strips shall be secured to a console, cabinet, rail, panel, etc. Wiring blocks shall not be used for Class II or 120 VAC power wiring.
- F. System Terminators: All partially opened boxes of terminators shall be turned over to the Resident Engineer to be counted as spare units.

1. Coaxial Cable:

- a. These units shall be metal housed precision types in the frequency ranges selected. They shall be the screw on or bayonet locking types that have low VSWR when installed and the proper impedance to terminate the required system unit.
- b. Technical Characteristics:

Impedance	52 Ohms
Working Voltage	As Specified
Capabilities	AC or DC Power Blocking, As Specified
Security Chain	Required

2. Audio Cable:

- a. These units shall be metal housed precision types in the frequency ranges selected. They shall be as specified by the OEM for the specific cable and/or system installed and the proper impedance to terminate the required system unit.
- b. Technical Characteristics:

Impedance	600 Ohms Balanced, 50K minimum, Unbalanced
Working Voltage	As Specified
Capabilities	As Specified
Security Chain	Required at the direction of the OEM

3. Audio Barrier Strips and/or Wiring Blocks:

- a. These units shall be forked precision types for barrier strips and push on type for wiring blocks in the frequency ranges selected. They shall be as specified by the OEM for the specific cable and/or system installed and the proper impedance to terminate the required system unit.
- b. Technical Characteristics:

Impedance	600 Ohms Balanced
Working Voltage	As Specified
Capabilities	As Specified
Security Chain	Required at the direction of the OEM

G. Raceways:

1. Intercommunication and Program System Raceways and Boxes: Comply with requirements in Division 16, Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
2. Each raceway that is open top, shall be: UL certified for telecommunications systems, partitioned with metal partitions in order to comply with NEC Parts 517 and 800 to "mechanically separate telecommunications systems of different service, protect the installed cables from falling out when vertically mounted and allow junction boxes to be attached to the side to interface "drop" type conduit cable feeds.
3. Intercommunication system cable infrastructure: EMT above accessible ceilings, 24 inches on center.

H. System Conduits:

1. AC Power: The conduit shall be a minimum 19 mm (3/4 inch) Outside Diameter (O.D.) Electrical Metallic Tubing (EMT). Master AC power conduit and conduit installation specifications and requirements are given herein.
2. Signal: The conduit shall be a minimum 25 mm (1.0 inch) O.D. EMT. Master signal conduit and conduit installation specifications and requirements are given herein.

I. Conduit Sleeves:

1. The Engineer has made a good effort to identify where conduit sleeves through full-height and fire rated walls on the drawings,

and has instructed the electrician to provide the sleeves as shown on the drawings.

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

J. Device Backboxes:

1. Furnish to the electrical contractor all backboxes required for the PAS devices.
2. The electrical contractor shall install the backboxes as well as the system conduit. Coordinate the delivery of the backboxes with the construction schedule.

2.8 UNINTERRUPTIBLE POWER SUPPLY (UPS)

- A. Provide a backup battery or a UPS for the system to allow normal operation and function (as if there was no AC power failure) in the event of an AC power failure or during input power fluctuations for a minimum of 30 minutes.
- B. As an alternate solution, the telephone system UPS may be utilized to meet this requirement at the head-end location, as long as this function is specifically approved by the Telephone Contractor and the RE.
- C. The Radio Contractor shall not make any attachments or connection to the telephone system until specifically directed to do so, in writing, by the Resident Engineer.
- D. Provide UPS for all active system components including but not limited to:
 1. Radio Base/Repeater Stations.
 2. Local/Remote Control Units.
 3. Personal Computers (when a part of the systems).
- E. Provide 1 spare UPS unit for each 10 units installed.

2.9 INSTALLATION KIT

- A. The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, wiring blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, etc., required to accomplish a neat and

secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or wiring block. Unfinished or unlabeled wire connections shall not be allowed. All unused partially opened installation kit boxes, coaxial cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, and physical installation hardware shall be turned over to the RE. This is an acceptable alternate to the individual spare equipment requirement as long as the minimum spare items are provided in this count. The minimum required installation sub-kits are as follows:

B. System Grounding:

1. The grounding kit shall include all cable and installation hardware required. All radio equipment shall be connected to earth ground via internal building wiring, according to the NEC.
2. This includes, but is not limited to:
 - a. Coaxial Cable Shields
 - b. Control Cable Shields
 - c. Data Cable Shields
 - d. Equipment Racks
 - e. Equipment Cabinets
 - f. Conduits
 - g. Cable Duct
 - h. Cable Trays
 - i. Power Panels
 - j. Connector Panels

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

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

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

F. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to

interface systems and sub-systems according to the OEM requirements and this document.

- G. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to completely and correctly label each sub-system according to the OEM requirements, record drawings, and this document.
- H. Documentation: The documentation kit shall include any item or quantity of items, computer discs, record drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide the system documentation as required by this specification document and explained herein.

2.10 SYSTEM PERFORMANCE

- A. The system shall meet the following minimum performance standards
1. Radio Standards:

Emission Designator	16K00F3E
Power Output	100 Watts (W) maximum, or as specified by the Station Operating License(s)
Operating Frequency	Designated Government Protected Frequencies as appears on the Station Operating License(s)
Frequency Stability	+0.005 percent
Signal to Noise (S/N) Ratio	50.0 decibel measured (dBm) at the Control Unit
Noise Figure	6.0 dB maximum measured receiver threshold
Automatic Gain Control (AGC)	40.0 dB Gain Variation Compensation
Mean Time Between Failure (MTBF) based on	50,000 hours minimum (at least 5 years) based on 24 hour day
Emission Designator	16K00F3E

2. Voice and Audio Standards:

Input and Output Signal Level--	0.0 dBm at 1 kilo Hertz (kHz) test tone modulation level. Each level shall be variable over a 6.0 dB range
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Input and Output Impedance	600 Ohms Balanced (Bal)
Input and Output Signals	Terminated on each Audio Control Unit
Frequency Range	50 Hertz (Hz) to 3.0 kHz + 1.0 percent, minimum
S/N Ratio	60 decibel per millivolt (dBmV) + 1.0 dBmV
Cross Modulation	-46 Db
Hum Modulation	-55 Db
Isolation (control unit to unit)	24 dB, minimum

3. Control Signal Standards:

Input and Output Signal	0.0 dBmV + 1.0 dBmV
Input and Output Signals	Terminated on each Radio Control Unit
Input and Output Impedance	600 Ohms, Bal
Channel Bandwidth	
Data	300 Hz to 3.5 kHz (9.6 kilo bits per second rate)
Voice	50 Hz to 3.0 kHz, + 5.0 percent, minimum
S/N Ratio	60 dBmV + 1.0 dBmV

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 (0050P3B) 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 Consultant in writing of any discrepancies.

3.3 NEEDS ASSESSMENT

Provide a one-on-one meeting with the particular nursing manager of each unit affected by the installation of the new two way radio / repeater 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. Locate overhead ceiling-mounted loudspeakers as shown on drawings, with minor changes not to exceed 12 inches in any direction.
- a. Mount transformers securely to speaker brackets or enclosures using screws. Adjust torsion springs as needed to securely support speaker assembly.
 - b. Speaker back boxes shall be completely filled with fiberglass insulation.
 - c. Seal cone speakers to their enclosures to prevent air passing from one side of the speaker to the other.
6. Finishes for any exposed work such as plates, racks, panels, speakers, etc. shall be approved by the Architect, Owner and 0050P3B.
7. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and surrounding wall. Where cover plates are not fitted with connectors, provide grommeted holes in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.
- B. Equipment Racks:
1. Fill unused equipment mounting spaces with blank panels or vent panels. Match color to equipment racks.
 2. Provide security covers for all devices not requiring routine operator control.
 3. Provide vent panels and cooling fans as required for the operation of equipment within the OEM' specified temperature limits. Provide adequate ventilation space between equipment for cooling. Follow manufacturer's recommendations regarding ventilation space between amplifiers.

4. Provide insulated connections of the electrical raceway to equipment racks.
 5. Provide continuous raceway/conduit with no more than 40 percent fill between wire troughs and equipment racks for all non-plenum-rated cable. Ensure each system is mechanically separated from each other in the wireway.
- C. Wiring Practice - in addition to the MANDATORY infrastructure requirements outlined in VA Construction Specification Section 27 10 00, STRUCTURED COMMUNICATIONS CABLING, the following additional practices shall be adhered to:
1. Comply with requirements for raceways and boxes specified in Division 26, Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
 2. Execute all wiring in strict adherence to the National Electrical Code, applicable local building codes and standard industry practices.
 3. Wiring shall be classified according to the following low voltage signal types:
 - a. Balanced microphone level audio (below -20dBm) or Balanced line level audio (-20dBm to +30dBm)
 - b. 70V loudspeaker level audio.
 - c. Low voltage DC control or power (less than 48VDC)
 4. Where raceway is to be EMT (conduit), wiring of differing classifications shall be run in separate conduit. Where raceway is to be an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications, which share the same enclosure, shall be mechanically partitioned and separated by at least 4 inches. Where Wiring of differing classifications must cross, they shall cross perpendicular to one another.
 5. Do not splice wiring anywhere along the entire length of the run. Make sure cables are fully insulated and shielded from each other and from the raceway for the entire length of the run.
 6. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.
 7. Replace the entire length of the run of any wire or cable that is damaged or abraded during installation. There are no acceptable methods of repairing damaged or abraded wiring.

8. Use wire pulling lubricants and pulling tensions as recommended by the OEM.
 9. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
 10. Do not use tape-based or glue-based cable anchors.
 11. Ground shields and drain wires as indicated by the drawings.
 12. Field wiring entering equipment racks shall be terminated as follows:
 - a. Provide ample service loops at harness break-outs and at plates, panels and equipment. Loops should be sufficient to allow plates, panels and equipment to be removed for service and inspection.
 - b. Line level and speaker level wiring may be terminated inside the equipment rack using specified terminal blocks (see "Products.") Provide 15 percent spare terminals inside each rack. Microphone level wiring may only be terminated at the equipment served.
 - c. If specified terminal blocks are not designed for rack mounting, utilize 3/4 inch plywood or 1/8 inch thick aluminum plates/blank panels as a mounting surface. Do not mount on the bottom of the rack.
 - d. Employ permanent strain relief for any cable with an outside diameter of 1 inch or greater.
 13. Use only balanced audio circuits unless noted otherwise
 14. Make all connections as follows:
 - a. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.
 - b. For crimp-type connections, use only tools that are specified by the manufacturer for the application.
 - c. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.
 - d. Wire nuts, electrical tape or "Scotch Lock connections are not acceptable for any application.
- D. Cable Installation: In addition to the MANDATORY infrastructure requirements outlined in VA Construction Specification Section 27 10 00, STRUCTURED COMMUNICATIONS CABLING, the following additional practices shall be adhered to:
1. Support cable on maximum 2'-0" centers. Acceptable means of cable support are cable trays. 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. Provide necessary rows 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 inch (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2 inch (minimum) past the Heat-shrink and serve as indicated below.
 9. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing $\frac{1}{4}$ 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, 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 de-reeling. Heat lamps shall not be used.
 15. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
 16. Separation of Wires: (Refer to Raceway Installation) Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
 17. Serve all cables as follows:
 - a. Cover the end of the overall jacket with a 1 inch (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2 inch (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2 inch (minimum) past the Heat-shrink and serve as indicated below.
 - b. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing $\frac{1}{4}$ inch past the end of unused wires, fold back over jacket and secure with cable tie.
 - c. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.
- E. Labeling:
1. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
 2. Engrave and paint fill all receptacle panels using 1/8 inch (minimum) high lettering and contrasting paint.
 3. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8 inch (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment.
 4. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.
 5. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively,

- computer generated labels of the type which include a clear protective wrap may be used.
6. Contractor's name shall appear no more than once on each continuous set of racks. The Contractor's name shall not appear on wall plates or portable equipment.
 7. Ensure each OEM supplied equipment has appropriate UL Labels / Marks for the service the equipment is performed permanently attached / marked. Equipment installed not bearing these UL marks will not be allowed to be a part of the PAS system. The contractor shall bear all costs required to provide replacement equipment with approved UL marks.

3.5 PROTECTION OF NETWORK DEVICES

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 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, common mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
- C. Install grounding electrodes as specified in Division 26, Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- D. Do not use "3rd or 4th" wire internal electrical system conductors for ground.
- E. Do not connect system ground to the building's external lightning protection system.
- F. Do Not "mix grounds" of different systems.

PART 4 - TESTING / WARRANTY / TRAINING

4.1 SYSTEM CLASSIFICATION

The Two Way Radio/Repeater System is NFPA listed as an "Emergency" Communications system. Therefore, the following testing and guaranty provisions are the minimum to be performed and provided by the contractor and Warranted by the OEM (re: Paragraph 1.1.A).

4.2 PROOF OF PERFORMANCE TESTING

- A. Intermediate Testing:
 - 1. After completion of 25 - 30 percent of the installation of a head end cabinet(s) and equipment, one local and remote enunciation stations and prior to any further work, this portion of the system must be pretested, inspected, and certified. Each item of installed

equipment shall be checked to ensure appropriate FCC listing & UL certification labels are affixed, NFPA, Emergency, Safety, and JCAHCO guidelines are followed, and proper installation practices are followed. The intermediate test shall include a full operational test.

2. The inspection and test will be conducted by a factory-certified 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 RE.

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) Antenna.
 - 2) Lightning Ground.
 - 3) Head End.
 - 4) Local and Remote Control Units/Enunciation Panels.
 - 5) All Networked locations.
 - 6) System interface locations (i.e. two way radio, PA, etc.).
 - 7) System trouble reporting.
 - 8) System electrical supervision.
 - 9) UPS operation.
 - 10) Primary/Emergency AC Power Requirements

11) 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 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 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 & 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 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 eight (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 antenna, 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 Antenna and Head End equipment test, the local // and remote // control unit 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 Radio System Audio and Control Signals meets all system performance standards.
 - d. Each system outlet and control point shall be functionally tested at the same time to verify that the Radio System Audio and Control Signals meets all system performance standards.
 - e. The system audio and volume stepper switches and control units shall be checked to insure proper operation.
 - f. Once these tests have been completed, each installed sub-system function shall be tested as a unified, functioning and fully operating system.
 - g. Individual Item Test: The Government Representative will select individual items of equipment for detailed proof of performance testing until 100 percent of the system has been tested and found to meet the contents of this specification. Each item shall meet or exceed the minimum requirements of this document.
3. Test Conclusion:

- a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the Resident Engineer. Any retesting to comply with these specifications will be done at the Contractor's expense.
 - b. If the system is declared unacceptable without conditions, all rescheduled testing expenses will be 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. RF Field Strength Meter.
 - e. Oscilloscope.
 - f. Polar Graph Plotter.

4.3 WARRANTY

- A. Comply with FAR 52.246-21, except that warranty shall be as follows:
- B. Contractor's Responsibility:
 - 1. The Contractor shall warranty 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 warranty period:
 - a. Response Time during the Warranty 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 warranty period.
 - 2) A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by the Resident Engineer (or Facility Contracting Officer), Monday through Friday exclusive of Federal Holidays.
 - 3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
 - a) A routine trouble call within 1 working day of its report. A routine trouble is considered a trouble that causes a pillow speaker or cordset, 1 master IC control station, room station or emergency station to be inoperable.
 - b) Routine trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) shall also be deemed as an emergency trouble call. The Resident Engineer (or Facility Contracting Officer) shall notify the Contractor of this type of trouble call.
 - c) An emergency trouble call within 4 hours of its report. An emergency trouble is considered a trouble that causes a sub-system (ward), distribution point, terminal cabinet, or all call system to be inoperable at anytime.
 - 4) If a Radio component failure cannot be corrected within 4 hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate Radio equipment. The alternate equipment/system shall be operational within a maximum of 20 hours after the 4 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 Warranty Period

- 1) The Contractor shall visit, on-site, as necessary, during the warranty 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 warranty 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.
- C. 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 all nursing staff assigned to those nursing units receiving new networked nurse/patient communications equipment. This training shall be developed and implemented to address two different types of staff. Floor nurses/staff shall receive training from their perspective, and likewise, unit secretaries (or any person whose specific responsibilities include answering patient calls and dispatching staff) shall receive operational training from their perspective. A separate training room will be set up that allows this type of individualized training utilizing in-service training unit, prior to cut over of the new system.
- B. Provide the following minimum training times and durations:

1. //48// hours prior to opening for nursing staff (in 8 hour increments) - split evenly over 3 weeks and day and night shifts. Coordinate schedule with Owner.
2. //32// hours during the opening week for nursing staff - both day and night shifts.
3. //24// hours for supervisors and system administrators.

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