SECTION 28 48 00 - EMERGENCY RADIO COMMUNICATION ENHANCEMENT SYSTEM (ERCES)

*******GENERAL NOTES**

1. This specification section is to be used for new in-building, two-way emergency radio communication enhancement systems (ERCES). These types of systems are often referred to by multiple names. NFPA 1221 uses the term Two-Way Radio Communications Enhancement Systems. The IFC and UL use the term Emergency Responder Communication Enhancement System (ERCES). In the field these can be referred to as BDA or DAS, both of which can be components of the overall system. For the purpose of this specification section all of these referenced systems will be referred to as "ERCES".

2. Where numbers, symbols, words, phrases, clauses, or sentences in this specification section are enclosed in brackets [ ], a choice or modification must be made; delete inapplicable portion(s) carefully. Where blank spaces occur in sentences, insert the appropriate data. Where entire paragraphs are not applicable, they should be deleted completely.

3. This section 28 48 00 has been developed for conformance with PBS-P100, 2021 edition, NFPA 72, 2022 edition, NFPA 1221, 2019 Edition, and International Fire Code (IFC), 2021 edition.

4. NOTES are provided to give additional information to the specification writer to make proper selections for the project. The notes are to be removed before the specification is published.

5. Specification Data: Verify that the titles of other sections of the project specification referred to in this section are correct, and if not, make the necessary editorial changes.

6. Where any code or standard referenced in this specification section refers to the Building Official, Fire Code Official, or Authority Having Jurisdiction for any fire protection or life safety interpretation or enforcement requirement, this refers to the GSA Regional Fire Protection Engineer. Where any code or standard referenced in this specification section refers to the Local Emergency Response Authority, this refers to the local fire official or other personnel who are responsible for the local Fire/EMS/Police radio system.

7. References made in this specification section to the GSA Regional Fire Protection Engineer are to be coordinated through the Contracting Officer.

*******GENERAL NOTES**

PART 1 - GENERAL

1.1 REFERENCES

A. The publications listed below form a part of this specification section to the extent referenced. The publications are referred to within the text by the basic designation only. Use the latest edition, unless noted otherwise.

B. Compliance with referenced codes and standards is mandatory. In the event of a conflict between specific provisions of this specification section and applicable codes and standards, this specification section will govern.

C. Federal Communications Commission (FCC)

1. FCC 47 CFR Part 90.219

D. FM GLOBAL (FM)

1. FM Approval Guide http://www.approvalguide.com/

E. GENERAL SERVICES ADMINISTRATION (GSA)

1. PBS-P100, GSA Facilities Standards for the Public Buildings Service.
2. PBS Standard for PBS CAD Deliverables.

F. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

1. IEEE C62.41.1, Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
2. IEEE C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

G. INTERNATIONAL CODE COUNCIL (ICC)

1. International Building Code®
2. International Fire Code®

H. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

1. NFPA 70, National Electrical Code®
2. NFPA 72, National Fire Alarm and Signaling Code®
3. NFPA 170, Standard for Fire Safety and Emergency Symbols
4. NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communication Systems

I. UNDERWRITERS LABORATORIES (UL)

1. UL 2524, In-building 2-Way Emergency Radio Communication Enhancement Systems
2. UL Fire Protection Directory, http://productspec.ul.com/index.php

1.2 NOTICE TO BIDDERS

A. Before submittal of bid, examine all drawings, specification, addenda, alternatives, special conditions, and all other bidding documents of all sections of this project, verifying all governing conditions at the site, and become fully informed as to the extent and character of the work required, as well as its relation to other work in the building. Submittal of a bid is an agreement

to all requirements of the contract documents and no consideration will be granted for any claimed misunderstanding thereof.

B. Submittal of a bid is deemed a representation by the bidder that he is qualified in all respects to properly perform the work for which he is bidding and has experience with similar work. Bidders are deemed to be aware, based on their background and experience, of materials which may be required in the discharge of their responsibilities, even though unspecified.

C. Where any code or standard referenced in this specification section refers to the Building Official, Fire Code Official, or Authority Having Jurisdiction for any fire protection or life safety interpretation or enforcement requirement, this refers to the GSA Regional Fire Protection Engineer.

D. Any reference to " Local Emergency Response Authority" must be interpreted to mean the local jurisdiction fire chief or other designated authority charged with the administration of the local code pertaining to emergency radio communication enhancement systems.

E. References made in this specification section to the GSA Regional Fire Protection Engineer must be coordinated through the Contracting Officer.

F. Any construction permits necessary as required by the Local Emergency Response Authority for the installation of the work, including all documentation, must be obtained prior to the commencement of the work.

G. Contractor must supply, test and determine locations of components which are required for proper operation as well as to supply, deploy, test and certify the performance of the complete system. .

H. The contractor must design any portions of the system that are not indicated on the drawings or specified herein, including locating and sizing wires, supports, control panels, and power supplies. The design of the system must be such that the installed system meets or exceeds the performance standards contained in this section, including referenced standards.

1.3 SYSTEM DESCRIPTION

A. Provide a new, complete, in-building two-way emergency radio communication enhancement system (ERCES) as described herein[and on the contract drawings] for the [insert name and address of building]. Radio communication coverage must be provided for the entire building.

B. The fire command center, fire pump room, exit stairs, exit passageways, elevator lobbies, standpipe hose outlets, sprinkler sectional valve locations and similar critical areas must be provided with acceptable radio coverage over 99% of the aggregate floor area.

*****NOTE***

NFPA 1221 permits 90% for general building areas while IFC requires 95% coverage.

*****NOTE***

C. General building areas must be provided with radio coverage over 95% of the aggregate floor area.

D. The system must comply with all applicable sections of the FCC rules. All signal boosters and other active system components must have FCC certification prior to installation. The equipment FCC Identification (ID) must be shown on the product datasheets and technical submittals. The ID must also be displayed on the product as required by the FCC.

E. Except as modified herein, the system must be designed and installed in accordance with the requirements of the IFC, NFPA 70, NFPA 72, NFPA 1221, and UL2524. Use the latest edition of each of these documents, except as otherwise or additionally specified herein

F. All components must be listed for their intended use and must be compatible with the overall system and its other components. Where the term "listed" appears in this specification section, it means UL-listed (UL Fire Protection Directory), FM-approved (FM Approval Guide), or listed by a nationally recognized testing laboratory (NRTL). The omission of these terms under the description of any item of equipment described must not be construed as waiving the requirement for listing or approval. All listings or approvals must be based on an existing ANSI, FM or UL published standard.

1.4 SUBMITTALS

*****NOTE***

Coordinate with the LERA to determine appropriate requirements for submittals and approval.

*****NOTE***

A. Installation of the ERCES is not permitted until qualifications, shop drawings, calculations and product data have been submitted and approved by [the Local Emergency Response Authority][and][the GSA Regional Fire Protection Engineer].

B. Qualifications: Prior to performing any work, the Contractor responsible for the ERCES design and installation must submit [one][___] electronic copy in pdf format of the following, no later than 30 calendar days prior to shop drawing submittal, in accordance with the General Conditions of the Contract.

1. Personnel qualifications of the system designer and lead installation personnel must include both of the following:

   a. A valid FCC-issued general radio operator’s license
   b. Certification of in-building system training issued by an approved organization or approved school, or a certificate issued by the manufacturer of the equipment being installed.

2. Documentation showing the Contractor has successfully installed the ERCES system as specified herein or that the Contractor has a contractual agreement with a Subcontractor having such experience. The data must include the names and locations of at least five

installations that have been in operation for at least 3 years, where the Contractor, or if the work will be performed by a Subcontractor, the Subcontractor, installed such systems. The Contractor, or Subcontractor, must certify that each system has performed satisfactorily for a period of not less than one year.

3. Contractor qualifications must include key personnel contact information (e.g., project manager, designer, superintendent, etc.), previous similar project history, duration of experience, licenses, and any other relevant documentation. Once approved, the representative must not be changed without approval in writing by GSA.

4. Manufacturer's technical representative's name and qualifications.

C. Submit [three copies][six copies][and][one electronic copy in pdf format] of the following, no later than 21 calendar days prior to the start of system installation, in accordance with the General Conditions of the Contract. Drawings, unless noted otherwise, must be no smaller than [the Contract Drawings][22-inch by 34-inch].

1. Shop Drawings (Working Plans): Detailed drawings must be in accordance with the requirements prescribed in NFPA 72, NFPA 1221, and NFPA 170 for Working Plans.

   a. Drawings must include plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance.
   b. Provide full size shop drawings not smaller than 1:1/8 in (100 mm) scale.
   c. Shop drawings must include a complete riser diagram and installation drawings that indicate all required ERCES system components and their location in the building.
   d. Floor plan drawings may include elevation detail names for each elevation view. Sheet title must include site name, address, sheet number, floor plan number and north arrow. Include site plan view of the subject buildings and surrounding property to clearly indicate the location and orientation of roof mounted outdoor antennas associated with the proposed system.
   e. Each set of drawings must include the following:
      1) A descriptive index with drawings listed in sequence by number.
      2) A legend sheet identifying device symbols, nomenclature, and conventions used in the package.
      3) Include a minimum of (1) building elevation depicting the location of any outdoor antennas associated with the proposed system. Include height of antenna centerline above building, orientation, and location of all external grounding connections.
      4) Include a detail plan view of all telecommunications spaces housing head-end and/or other consolidated equipment, showing the location of the rack(s) and/or enclosure(s) of the equipment.
      5) Include a separate plan view of each interior floor where indoor antenna systems are proposed. Include antenna numbers, coaxial cable routes, and the locations of any other system components including splitters, couplers, filters, amplifiers, etc. All components must be named or labeled for reference in power budget calculations tables. Overlay approximated

coverage radii indicating –95 dBm downlink (base to mobile) signal strength around each proposed indoor coverage antenna. Include results of any previous coverage testing per grid, if available.

6) Include a minimum of one (1) detail elevation view(s) of all rack(s) and/or enclosure(s) housing the equipment. Identify each piece of equipment by brand, model number and equipment type (e.g. Acme BA123 RF amplifier).
7) Specify antenna grounding and surge protection in accordance with NEC Article 810.
8) Specify the backup power source, and include calculations to ensure the backup power requirements as specified in this standard are met.

2. Wiring Diagrams: Submit wiring diagrams from the manufacturer. Include diagrams for each component of the system with all terminals and interconnections identified. Make all diagrams specific to this Project.

3. Product data: Provide annotated catalog data showing manufacturer's name, model, and catalog numbers for all equipment and components to be used in this project. At a minimum the following equipment and components must be provided:

a. Bi-directional amplifiers
b. Distributed antenna system
c. Coaxial cables
d. Splitters and direction couplers
e. Cable taps
f. UPS
g. Wiring
h. Raceway
i. Raceway fittings
j. Junction boxes
k. Cabinets
l. Cabinet locks & keys
m. Panel signage
n. Connectors
o. Cables
p. Overcurrent devices
q. Backup battery and charging system
r. Pass band curves in for the uplink and downlink portions of the NPSPAC band for any amplifiers, if not included in #1. Amplifiers may NOT amplify portions of other licensed services, including Nextel and Specialized Mobile Radio Licensee band, or Cellular A or B bands.
s. All other equipment and components necessary for a complete and functioning system.

D. Redline As-Built Drawings: Maintain a separate set of approved submittal drawings of the overall system, redline marked-up to indicate as-built conditions, on site in a document storage cabinet. These drawings must be in a current condition at all times, and must be made available for review immediately upon request during normal working hours. Redline drawings must be

color scanned to .pdf format and submitted a minimum of 7 calendar days prior to the final acceptance test of the system.

E. As-Built Drawings: Submit [three copies][six copies] [one electronic copy in pdf format] containing CAD based drawings, in the latest version of AutoCAD and DXF format,] and pdf of as-built drawings and schematics. Variations from approved drawings, for whatever reason, including those occasioned by modifications, change orders, optional materials, or required for coordination between trades must be indicated in sufficient detail to accurately reflect the as-built conditions. As-built drawings must be submitted within 14 calendar days after the final acceptance test of the system.

F. Technical information documents must contain, as a minimum, the following:

1. Frequencies required for the in-building enhancement system
2. Location and effective radiated power (ERP) of radio sites used by the public safety radio enhancement system
3. Maximum propagation delay — in microseconds
4. List of specifically approved system components
5. Other supporting technical information necessary to direct system design

G. Operation and Maintenance Data: Submit [one copy][three copies][and][one electronic copy in pdf format] of manuals[in loose-leaf binder format and[grouped by technical sections consisting of manufacturer's brochures, schematics, printed instructions, general operating procedures, and safety precautions. Manuals must be submitted and approved by the GSA Regional Fire Protection Engineer prior to on-site training. [In addition to items specified in Division 01 Section 017823 "Operation and Maintenance Data", the][The] Manual must include the following documents and information at a minimum:

1. A general description of the design and operation of the system(s).
2. A copy of the as-built design drawings in 11 x 17-inch format, folded neatly within the binder.
3. All applicable product installation sheets annotated as necessary.
4. Step-by-step procedures required for system startup, operation, and shutdown, including the sequence or sequences of operation of the overall system.
5. The manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features.
6. A maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guide, and system warranty information.
7. A routine maintenance checklist. The routine maintenance checklist must be arranged in columnar format. The first column must list all installed devices, the second column must state the maintenance activity or state no maintenance required, the third column must state the frequency of the maintenance activity, and the fourth column for additional comments or reference.

H. Training Documentation: Submit [one copy][three copies][and][one electronic copy in pdf format] in manual format, operating instructions, maintenance procedures, and training data for the training courses. The operations training must familiarize the Government's designated personnel with proper operation of the installed system. The maintenance training course must

provide the Government’s designated personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

1.5 QUALITY ASSURANCE

A. The recommended practices stated in the manufacturer’s literature or documentation must be considered as mandatory requirements.

B. Qualifications – Design Services: Shop (working) drawings and calculations must be prepared under the directions of and signed by a qualified design professional in ERCES.

C. Qualification - Installer

1. Installation must be accomplished by an electrical or emergency communications contractor with a minimum of three years’ experience in the installation of ERCES.
2. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, must provide additional technical support at the site as required by the Contracting Officer’s Representative.
3. Qualifications will be rejected if evidence of all qualifications cannot be provided.

D. Qualifications - Test Personnel: Technicians with a minimum of four years of experience must be utilized to test and certify the installation of the emergency radio communication enhancement system devices, cabinet, control units, and all equipment. The technicians testing the equipment must be factory-trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

E. [Qualifications - Supervisor/Foreman: Personnel with a minimum of four years of appropriate experience in ERCES installation. A supervisor/foreman must be on-site at all times when work is being performed. The supervisor/foreman is permitted to perform installation tasks (i.e. working foreman).]

1.6 VERIFYING ACTUAL FIELD CONDITIONS

A. Before commencing work, examine all adjoining work on which the contractor's work is in any way dependent for perfect workmanship according to the intent of this specification section, and report to the Contracting Officer’s Representative any condition which prevents performance of first-class work. No "waiver of responsibility" for incomplete, inadequate, or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.

1.7 COORDINATION OF TRADES

A. The contract documents are not intended to serve as coordinated construction drawings showing all minor adjustments in locations required for a fully coordinated installation that respects the work of all trades.

B. Conduit, fittings, and any other accessories required must be furnished as required to provide a complete installation and to eliminate interference with other construction.

C. Provide required supports and hangers for conduit, antenna, and equipment, so that loading will not exceed allowable loadings of structure. Submittal of a bid must be deemed a representation that the contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing required support.

D. Field drilling and cutting of holes in structural decks, roofs, walls, etc. required for work under this section must be coordinated through various trades in their respective materials. All such drilling, cutting, and reinforcing costs must be borne by the contractor.

E. [Due to the type of installation, a fixed sequence of construction is required to properly install the complete systems. It is the responsibility of the contractor to coordinate, protect, and schedule his work with other trades in accordance with the construction sequence.]

F. The Contractor must coordinate the Local Emergency Response Authority system work with other trades to avoid conflicts, assure system completion and testing within the project schedule and to assure a quality, workmanlike finished product. In occupied buildings the Contractor must coordinate all work with the GSA Property Manager to limit the disruptions to government business and activities. This may mean altered scheduling, after hours work, and/or sequencing construction activities to avoid disruptions to occupants of the building.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect equipment delivered and placed in storage from the weather, humidity, and temperature variation, dirt and dust, and other contaminants in accordance with manufacturer's instructions.

B. Coordinate the storage arrangement and location with the Contracting Officer’s Representative.

C. Deliver and store products in shipping containers or boxes, with labeling in place.

1.9 WASTE REMOVAL

A. At the conclusion of each day's work, clean up and stockpile on site all waste, debris, and trash, which may have accumulated during the day as a result of work by the contractor and of their presence on the job.

1.10 EXTRA MATERIALS

A. Repair Service/Replacement Parts: During warranty period, the service technician must be on-site within 24 hours after notification. All repairs must be completed within 24 hours of arrival on-site.

B. Interchangeable Parts: Spare parts furnished must be directly interchangeable with the corresponding components of the installed system. Spare parts must be suitably packaged and identified by nameplate, tagging, or stamping. Spare parts must be delivered to the Owner at the time of final acceptance testing.

C. Special Tools: Software, connecting cables, and proprietary equipment necessary for the maintenance, testing, and reprogramming of equipment must be furnished to the Owner.

D. Documentation Cabinet: A wall-mounted, metal, locking cabinet, no less than 22 gage steel, must be provided and installed adjacent to the system control unit or another approved location as directed by the Owner's Representative. The cabinet must be sized to fit all system record documentation and one copy of the O&M manual and training manual. The cabinet must be prominently and permanently labeled "SYSTEM RECORD DOCUMENTS". The spare parts cabinet and document cabinet can be combined into one unit.

1.11 WARRANTY

A. Warranty and Guarantees: The Contractor must comply with the requirements of FAR 52.246-21 Warranty of Construction and GSAR 552.246-75 Guarantees. Final Acceptance includes, but is not limited to, successful final acceptance testing, the receipt of approved as-built drawings and the receipt of approved operation and maintenance manuals.

B. The contractors must provide required inspection, testing and maintenance as a part of this contract to maintain the system warranty. Inspection, testing and maintenance as well as service calls during the warranty period will be performed at no additional expense to the government.

C. The Contractor must furnish evidence that the Emergency Radio Communication supplier has an experienced and effective service organization that carries a stock of repair parts for the system in order to readily effect repairs throughout the warranty period. Should the Contractor fail to comply with the service requirements of this section, the Government may make the necessary repairs and back charge the Contractor without any loss of warranty or guarantee as provided by the contract documents.

D. The contractor must provide a service organization, during the warranty period, that has an established office, which has been in existence for a minimum of five years and is so located where the response to the project site can occur within [24][__] hours or less. The service organization must be available 24 hours a day, 7 days a week for repairs during the construction and subsequent warranty period. On-site service during the warranty and guarantee period must be provided within two (2) hours after notification. All repairs must be completed within 48 hours after notification.

1.12 [EXISTING ERCES SYSTEMS AND EQUIPMENT

A. Any existing systems and equipment must be maintained fully operational until the new equipment has been tested and accepted by the Government.

1. As new equipment is installed, existing equipment must be tagged “NOT IN SERVICE” until the new equipment is accepted by the Government.
2. All new equipment that has been placed in service, must have tags removed immediately and tags stating “NOT IN SERVICE” must be placed on existing equipment that is no longer in service until such equipment is removed from the building. The switchover from the existing equipment to the new equipment must be sequenced as indicated on the drawings and in the specifications.
3. “NOT IN SERVICE” tags must be of such a material and installed in such a way as to not leave adhesive residue on the new equipment nor impair the new equipment in any way.

B. Equipment Removal: After acceptance of the new system by the Government, all existing equipment (including wire, antenna, conduit, etc.) not connected to the new system must be removed. All damaged surfaces must be restored to a condition deemed acceptable by the government. The material must be removed from the site and disposed of by the Contractor. The only exception to this requirement is when removal of existing equipment will damage historic fabric. This exception may only be exercised with the written permission of both the GSA Regional Fire Protection Engineer and the GSA Regional Historic Preservation Officer.]

1.13 [DOCUMENT SECURITY

*****NOTE***

Contact the Contracting Officer to determine if this specification section is required to be marked as CUI.

*****NOTE***

A. All Controlled Unclassified Information (CUI), either in electronic or paper formats, must be appropriately marked.

B. Drawings, test reports, O&M data and training documentation must be provided with a CUI coversheet or label complying with SF901 or SF902.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Standard Products: Material and equipment must be the standard products of a manufacturer, where possible, and not a combination of manufacturers for any particular classification of materials. Materials and equipment must be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening. All materials and equipment supplied must be new, first quality and the manufacturer's best type and latest model capable of complying with all requirements of this specification section and must have been in continuous production and in continuous service in commercial applications for at least one-year. Obsolete equipment must not be used.

B. Compatibility: The equipment, including but not limited to, repeaters, transmitters, receivers, signal boosters, cabling, fiber distributed antenna system, etc., must not interfere with the existing communication systems utilized by the Public Safety and First Responder agencies.

C. Nameplates: All equipment must have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number. Nameplates must be etched metal or plastic, permanently attached by screws to equipment or adjacent walls.

D. The system must be complete with all components and wiring required for compliance with all applicable codes and regulations, and for its operations described hereinafter.

2.2 EQUIVALENT TECHNOLOGIES

A. Nothing in this specification section is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed in this specification section. Technical documentation of equivalent technologies must be submitted to the Contractor Officer. The system, method, or device must be approved for the intended purpose by the GSA Regional Fire Protection Engineer prior to start of construction.

2.3 SYSTEM REQUIREMENTS

A. Prior to installation, all radio-frequency (RF) emitting devices and cabling must have the certification of the radio licensing authority and be suitable for public safety use.

B. The In-building emergency radio communication enhancement system must provide the following signal strengths:

1. Downlink - Minimum inbound signal strength must be sufficient to provide usable voice communications throughout the coverage area. The inbound signal level must be a minimum of -95dBm throughout the coverage area and sufficient to provide not less than a Delivered Audio Quality (DAQ) of 3.0 throughout the coverage area, or an equivalent signal-to-interference-plus-noise ratio (SINR) applicable to the technology for either analog or digital signals.
2. Uplink – Minimum outbound signal strength must be sufficient to provide usable voice communications throughout the coverage area. The outbound signal level must be sufficient to provide not less than a DAQ of 3.0 or an equivalent SINR applicable to the technology for either analog or digital signals, received at the public safety communication system.

C. The system must comply with all applicable sections of the FCC rules. All signal boosters and other active system components must have FCC certification prior to installation. The equipment FCC ID must be shown on the product datasheets and technical submittals. The ID must also be displayed on the product as required by the FCC.

D. A dedicated supervised monitoring panel must be provided at the building fire alarm control panel [within the fire command center] [and] [other locations as designated by Local Emergency

Response Authority] to annunciate the status of all signal booster locations. The monitoring panel must provide visual and labeled indication of the following for each of these supervisory signals:

1. Loss of normal AC power
2. Battery charger failure
3. Loss of battery capacity (70% depletion)
4. Donor antenna malfunction
5. Active RF emitting device malfunction
6. System component malfunction (other than passive RF Component)
7. Failure of the communications link between the fire alarm system and the in-building, two-way ERCES.

E. All repeater, transmitter, receiver, signal booster components, optical-to-RF and RF-to-optical converters, external filters, batteries, and battery system components must be contained in a NEMA4-type approved waterproof cabinet. All enclosures must be painted red with identification signage.

F. Active RF-emitting devices must have built in oscillation detection and control circuitry.

G. The system must be capable of modification or expansion in the event that frequency changes are required by the FCC or other radio licensing authority, or additional frequencies are made available.

2.4 [DONOR ANTENNA(S):

A. Isolation must be maintained between the donor antenna and all inside antennas to not less than 20dB greater than the system gain under all operating conditions.

B. Donor antennas must be permanently affixed on the building or where approved, mounted on a movable shed with a clearly visible sign stating “MOVEMENT OR REPOSITIONING OF THIS ANTENNA IS PROHIBITED WITHOUT APPROVAL FROM THE FIRE CODE OFFICIAL.”]

2.5 SIGNAL BOOSTERS

A. The signal booster must have both the primary and the secondary power supplies built in a fully sealed NEMA-4 type approved enclosure.

B. Signal Boosters must have oscillation prevention circuitry to protect the public safety radio system in case of signal booster malfunction.

C. Signal Booster gain must be rated at minimum of 80dB, and the gain must be adjustable in a minimum of 25dB range. System gain must be set and documented at the time of the final system test.

D. Maximum Propagation delay of the signal booster system must be 14µs (microseconds) or as specified by Local Emergency Response Authority. The signal booster system must include six

alarm relay outputs with line termination for fire alarm panel connection for monitoring the signal booster.

E. The signal booster must be a Class B Public Safety type as designated by the FCC and as required by the Local Emergency Response Authority. The signal booster must be set and tuned by the equipment manufacturer to pass frequencies as specified by the Local Emergency Response Authority.

2.6 CABINET / LOCK AND KEY

A. Keys and locks for equipment must be identical. Provide not less than six keys of each type required. Master all keys and locks to a single key.

B. Provide one copy of each type of key in the building's Knox box.

2.7 PRIMARY ELECTRIC POWER

A. Power must be 120 VAC service from the emergency or normal AC service to the building.

2.8 SECONDARY POWER SUPPLY

A. Provide for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power must be automatic and must not cause transmission of a false alarm.

B. Batteries: Provide sealed, maintenance-free, lead-acid batteries as the source for emergency power. Batteries must contain suspended electrolyte. The battery system must be maintained in a fully charged condition by means of a solid-state battery charger.

1. Capacity: Battery size must have sufficient capacity to operate the system under normal conditions for [12][__] hours.
2. Battery Power Calculations: Verify that battery capacity exceeds supervisory and alarm power requirements. Substantiate the battery calculations for alarm, alert, and supervisory power requirements. Include ampere-hour requirements for each system component and each control unit component. Include a 1.2 derating factor in all calculations.

C. Battery Chargers: Provide a solid-state, fully automatic, variable charging rate battery charger. The charger must be capable of providing 120 percent of the connected system load and must maintain the batteries at full charge. In the event the batteries are fully discharged (20.4 VDC), the charger must recharge the batteries back to 95 percent of full charge within 48 hours after a single discharge cycle as described in paragraph Capacity above.

2.9 LINE VOLTAGE SURGE PROTECTIVE DEVICES

A. Line voltage surge protective devices must be provided to suppress all voltage transients which might damage system control unit components. The surge protective device must wire in series to the power supply of the protected equipment with screw terminations. Line voltage surge arrester must be installed directly adjacent to the power panel where the breaker is located.

B. Line voltage surge protective devices for nominal 120 VAC must be UL 1449 listed with a maximum 500 volt suppression level and have a maximum response time of 5 nanoseconds. The surge protective device must feature multi-stage construction and be provided with a long-life indicator lamp (either light emitting diode or neon) which extinguishes upon failure of protected components. Any unit fusing must be externally accessible.

C. Line voltage surge protective device for nominal 24 VAC, for alarm telephone dialer or ethernet connection, must be UL 497B listed and have a maximum response time of 1-nanosecond. The surge protective device must feature multi-stage construction and be self-resetting. The surge protective device must be base and plug style. The base assembly must have screw terminals for wiring. The base assembly must accept a “plug-in” surge protective module.

D. All surge protective devices (SPD) must be the standard product of a single manufacturer

2.10 LIGHTNING PROTECTION

A. The system must have lightning protection that complies with NFPA 780.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. Assembly and installation of all components of the ERCES system must comply with all applicable sections of NFPA 70, NFPA 72, NFPA 1221, Local Emergency Response Authority requirements and manufacturer’s installation instructions.

B. The signal booster must be designed to allow degraded performance in adverse conditions, such as high temperatures in the event of heat from a nearby fire, voltage fluctuations or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) are not acceptable.

C. The ERCES must provide the following signal strengths:

1. Downlink - Minimum inbound signal strength must be sufficient to provide usable voice communications throughout the coverage area. The inbound signal level must be a minimum of -95dBm throughout the coverage area and sufficient to provide not less than a Delivered Audio Quality (DAQ) of 3.0 throughout the coverage area, or an equivalent

signal-to-interference-plus-noise ratio (SINR) applicable to the technology for either analog or digital signals.

2. Uplink – Minimum outbound signal strength must be sufficient to provide usable voice communications throughout the coverage area. The outbound signal level must be sufficient to provide not less than a DAQ of 3.0 or an equivalent SINR applicable to the technology for either analog or digital signals, received at the public safety communication system.

D. Survivability

1. Comply with NFPA 1221.
2. Riser/backbone cables must be routed through an enclosure that matches the building's fire rating.
3. The connection between the riser cable and the antenna cables must be made within an enclosure that matches the building's fire rating.
4. Do not run cable in elevator shafts or exit stairways.
5. Amplifiers (if used) must be housed in a 2-hour fire rated enclosure.

E. Amplifiers and other electronic components must installed where they may be worked on by standing on the floor and not requiring a ladder to access them.

F. Antennas must be the only equipment mounted on the exterior of the building.

G. Provide identification signage in the fire command center and at all locations where a remote fire alarm annunciator is provided for fire department use. The signage must read: "This building is equipped with an Emergency Responder Radio Coverage System". Provide red sign with minimum one-inch white letters.

3.2 SYSTEM FIELD WIRING

A. Backbone, antenna distribution, radiating, or any fiber-optic cables must be plenum rated.

B. Radiating cable, if used, must be run without conduit. All other cable can be run in conduit if required for mechanical protection of the cable.

C. RF Coaxial Cable must be a fire-resistant, low-smoke type, U.L. classified as plenum. The classification must be clearly marked on the outer surface of the cable regular intervals. Where mechanical protection of cable is required, it must be run in conduit.

D. Install coaxial cable or Radiax cable in approved locations and properly firestop any penetrations of fire rated construction. Permanently mark cable or Radiax every 10 feet to identify its use. Do not run cable in elevator shafts or in exit stairways.

E. Conductors that are installed in a vertical riser that connects two or more floors must meet the requirements of riser-rated cable and installation in accordance with NFPA 70.

F. Conduit: Use rigid metal conduit or electrical-metallic tubing with a minimum diameter of 3/4-inch. Provide all new conduit unless specifically noted otherwise on the drawings. Electrical

metallic tubing must use compression type fittings and couplings. The use of flexible metal conduit not exceeding a 6-foot length is permitted. Run conduit or tubing (rigid, IMC, EMT, FMC, etc., as permitted by NFPA 72 and NFPA 70) concealed unless specifically indicated otherwise on the drawings. Conduit may be exposed in unfinished mechanical/electrical rooms, basement, mezzanine, and penthouse levels.

G. Conductor Terminations: Labeling of conductors at terminal blocks in terminal cabinets and at head-end equipment must be provided at each conductor connection. Each conductor or cable must have a shrink-wrap label to provide a unique and specific designation.

3.3 FIRESTOPPING & FIREPROOFING

A. General: Firestop all holes for conduit, piping, or other penetrations which pass through floor slabs, fire-rated walls, partitions with fire-rated doors, vertical service shafts, or any fire-rated assemblies in accordance with Section 07 84 00. Existing holes through which new conduit for this project passes must be totally fire stopped in a manner that restores the fire protection rating of the penetrated wall, floor, ceiling, or other structure.

B. Where structural fireproofing is disturbed, damaged, or destroyed because of installation, the contractor must be responsible for restoring the fireproofing to the required fire resistance rating in an approved manner. This restoration must be done in accordance with Section 07 81 00.

3.4 LABELING AND IDENTIFICATION

A. Manufacturers conduit labeling must be visible.

3.5 FIRE ALARM CONNECTIONS

A. All connections between ERCES and the building fire alarm system must be performed by the fire alarm installer. Comply with the requirements of this section and Section [28 3176][28 3164].

3.6 FIELD QUALITY CONTROL

A. Testing Procedures: Submit detailed test procedures, prepared and singed by the qualified test personnel for the detection and alarm system 14 days prior to performing system tests. Detailed test procedures must list all components of the installed system. Test procedures must include sequence of testing, time estimate for each test, and sample test data forms. The test data form must be in a check-off format (pass/fail with space to add applicable test data) and must be used for the preliminary testing and the acceptance testing.

3.7 PRELIMINARY TESTS

A. General: Test the system in accordance with IFC, NFPA 72, NFPA 1221, Local Emergency Response Authority requirements and the manufacturer's specifications.

B. All preliminary tests must be conducted, documented, and signed by a person in possession of an FCC issued General Radio Telephone Operators License. All testing personnel must be certified and authorized by the equipment manufacturer in the installation and operation of their equipment.

C. Preliminary test documentation must include a listing of the following:

1. All system equipment utilized
2. Manufacturer's data sheets
3. Installation, testing, and maintenance documentation
4. As-built drawings showing all equipment locations
5. Written documentation acceptable to the AHJ of the initial system testing, including the DAQ measured at all locations in the building or areas covered by the installed system
6. Secondary power calculations
7. List of assigned frequencies

D. If equipment is found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests must be conducted and repeated, if necessary, until the system has been demonstrated to comply with all contract requirements.

1. Any such repeated tests as required by the Government must be done at no additional expense to the Government.
2. Repeated testing expenses must be borne by the contractor and include but not be limited to, contractor's direct and indirect expenses for repeating the testing, travel and professional expenses for GSA fire protection engineers, technicians, contracting officers, contracting officer's representatives, project managers and property managers, or their designees, and any other expense necessary to repeat final acceptance testing as required by this contract.

E. The Contractor must be in attendance at preliminary testing to make necessary adjustments. After preliminary tests are complete, and any necessary corrections made and retested, submit a letter that the installation is complete, compliant with the specification and fully operable. The letter must include the names and titles of the witnesses to the preliminary tests, preliminary test documentation and all completion documentation as required by NFPA 1221. Final testing will not be performed until after the connections to the building fire alarm system. Submit request for test at least [15][_____] calendar days prior to the requested test date.

3.8 FINAL ACCEPTANCE TEST

A. General: Test the system in accordance with IFC, NFPA 72, NFPA 1221, Local Emergency Response Authority requirements and the manufacturer's specifications.

B. All final tests must be conducted, documented, and signed by a person in possession of an FCC issued General Radio Telephone Operators License. All testing personnel must be certified and authorized by the equipment manufacturer in the installation and operation of their equipment.

C. The system will be considered ready for final acceptance testing only after the following have been accomplished.

1. Preliminary tests have been completed and deficiencies corrected.
2. Signed [Verification of Compliant Installation]letter formally requesting final testing submitted.
3. Testing reports have been submitted and approved by the Contracting Officer and the Local Emergency Response Authority.
4. Three (3) copies of Redlined Shop Drawings provided in electronic format (.pdf). Drawings must include readings from preliminary testing to the government for their use during the final acceptance testing.
5. O&M Manuals submitted.

D. Notify the GSA Contracting Officer's Representative in writing when preliminary testing is complete, and the system is ready for final acceptance testing. Submit request for testing at least 15 calendar days prior to the test date. A final acceptance test will not be scheduled until the O&M Manuals are provided to and approved by the Contracting Officer's Representative, the preliminary test certification letter is received by the Contracting Officer's Representative and marked-up red line drawings of the system as field installed, including readings for all areas of the project recorded during preliminary testing.

E. The contractor must ensure that representatives of all installing contractors and the ERCES manufacturers necessary to perform any and all testing are present for the final acceptance testing. Any delays or additional costs in testing or repeated testing necessary to complete this requirement because representatives were not on site for testing is not the responsibility of the Government.

F. Final acceptance testing must be coordinated and performed by the contractor, in the presence of the Contracting Officer's Representative, LERA representative and the GSA Regional Fire Protection Engineer (or their designee). The test must not be conducted until all parties agree on the scheduled test date. The contractor must provide all the necessary personnel and equipment to conduct the tests.

G. The Contractor must provide all personnel, equipment, tools, meters, ladders, and communication devices necessary for the performance of all tests. Government representatives are present to observe the testing and will not bring any equipment to perform testing.

H. If equipment is found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests must be conducted and repeated, if necessary, until the system has been demonstrated to comply with all contract requirements.

1. Any such repeated tests as required by the Government must be done at no additional expense to the Government.
2. Repeated testing expenses must be borne by the contractor and include but not be limited to, contractor's direct and indirect expenses for repeating the testing, travel and

professional expenses for GSA fire protection engineers, technicians, contracting officers, contracting officer's representatives, project managers and property managers, or their designees, and any other expense necessary to repeat final acceptance testing as required by this contract

I. [The contractor must perform all testing in occupied facilities at times of day that present the lowest impact and disruption to government business and activities. Coordinate all testing in occupied buildings with the Property Manager to assure that the testing does not interrupt government operations. This may require extensive after hours work to perform such testing.]

J. Damage done to the facility from improper testing is the responsibility of the contractor and is not an acceptable reason for schedule delays or additional costs to the government.

K. Upon satisfactory completion of the tests, the contractor must leave the system in proper working order.

3.9 WARRANTY

A. Except as otherwise expressly provided in the contract documents, the contractor must guarantee all work to be free of all defects of workmanship and materials for the warranty period after final acceptance of the work by the Contracting Officer's Representative. Include service directory with telephone numbers for 24-hour emergency service.

3.10 TRAINING

A. Instructor: Include in the project the services of an instructor, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided. The instructor must train the employees designated by the Government, in the care, adjustment, maintenance, and operation of the fire sprinkler system. Each instructor must be thoroughly familiar with all parts of this installation. The instructor must be trained in operating theory as well as in practical O&M work. Submit the instructor's information and qualifications included training history prior to training.

B. Required Instruction Time: Provide [4][8] hours of instruction after final acceptance of the system. The instruction must be given during regular working hours on such dates and times as selected by the Contracting Officer's Representative. The instruction may be divided into two or more periods at the discretion of the Contracting Officer's Representative. The training must allow for rescheduling for unforeseen maintenance.

END OF SECTION 28 48 00