

SECTION 287800 – EMERGENCY RESPONDER RADIO COVERAGE SYSTEM

PART 1 - GENERAL

1.1 INITIAL RADIO SIGNAL SURVEY (INCLUDE IN BASE BID)

- A. Include all costs in base bid for the Fire Alarm Contractor to conduct a radio signal survey immediately after building structure is complete, and prior to ceiling installation to determine signal coverage and strength of the municipality's emergency responder radio (public safety) system inside the project facility.
- B. Conduct a survey using a RF Spectrum Analyzer, a calibrated, system-compatible radio or another suitable instrument with traceable certificate of calibration to analyze the RF signal strength. Both inbound and outbound signal strength shall be determined, measured, calculated and documented as required by code and AHJ. Survey shall be performed by FCC GROL certified technicians. Survey shall include measurements at a minimum of 20 readings per floor or 1,600SF if the floor area exceeds 32,000SF and in all critical areas or as otherwise directed by AHJ.
- C. Survey report and drawing indicating measurements at each frequency band of interest shall be submitted to the AHJ for review. The report shall clearly indicate all areas that do not meet a minimum of -95dBm nominal uplink or downlink signal at 100% or a Delivered Audio Quality (DAQ) of 3.0.
- D. If measured levels determined to be insufficient, a complete Emergency Responder Radio Coverage (ERRC) system shall be provided in accordance with these specifications below. Cost for the system and installation will be paid through allowance.
- E. Contractor shall be responsible for scheduling survey so that all of the following is completed prior to the installation of ceilings:
 - 1. Conduct initial survey
 - 2. Submit survey results and report to the AHJ for review and determination of system requirements
 - 3. Provide system design and submit shop drawings to architect and AHJ for review

1.2 SCOPE (SEE ALLOWANCES)

- A. The contractor shall design, furnish, install, and warranty a complete Emergency Responder Radio Coverage (ERRC) system. The installed system shall include all hardware, bi-directional amplifiers, band-pass filters, surge suppressors, lightning protection, UPS, transmission lines, power cabling, antennas, and other components necessary for a complete operational system as specified and as acceptable to the local authorities having jurisdiction.
- B. Equipment manufacturer name and model numbers specified are provided to establish quality of equipment and system operational features. Any proposed substitution of equipment from that specified must be approved by the Architect within ten (10) days prior to bid date.
- C. The entire system shall be guaranteed for a period of one (1) year from the date of final acceptance of the installation and the Contractor shall repair or replace defective equipment, during this period, at no cost to the owner.
- D. Entire system shall be verified and approved by local AHJ to comply with all emergency responder radio network requirements including signal strength and frequency range.

1.3 DEFINITIONS

- A. BDA: Bi-Directional Amplifier is a two-way signal booster that is used to amplify band-selective or multi-band RF signals in the uplink, to the base station and in the downlink from the base station to subscriber devices for enhanced signals and improved coverage.
- B. DAS: Distributed Antenna System is a network of separate antenna nodes connected to a common transport medium.
- C. ERRC: Emergency Responder Radio Coverage System is a complete in-building radio communication system that brings wireless signals into a structure from outside, amplifies those signals with a signal booster (BDA), and then evenly distributes the amplified signals throughout a structure via a Distributed Antenna System (DAS). The system also amplifies signals originating inside the building and transmits them outside.
- D. Donor Antenna: Antenna that receives and transmits signal to radio system outside of facility.

1.4 STANDARDS

- A. The system shall comply with all requirements of the latest edition of each of the following codes and standards. The latest edition of these codes and standards form a part of this specification:
 - 1. U.L. Standard 2524.
 - 2. International Fire Code Section 510
 - 3. NFPA 1225
 - 4. NFPA 72
 - 5. All requirements of local Fire Department, Building Department and all other authorities having jurisdiction (AHJ)

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For headend and distribution system. Include plans, elevations, sections, details and attachments to other work.
 - 1. Show fabrication and installation details for equipment.
 - 2. Functional Block Diagram: Show single-line interconnections between components for headend and distribution system. Show cable types and sizes.
 - 3. Dimensioned Plan and Elevations of Headend Equipment: Show access and workspace requirements.
 - 4. Wiring Diagrams: For power, signal, and control wiring and transmission cable, include cross connects, taps, and other connections cords.
- C. Design Calculations: Calculate signal attenuation budget and show calculated line and equipment losses for the system based on the functional block diagram, to show that proposed system layout can be expected to perform up to specification. Calculate signal strength from sources to endpoints. Allowable losses between components and user interface shall be used to determine size and type of cable.
- D. Coordination Drawings: Include dimensioned plan and elevation views of components and enclosures. Show access and workspace requirements.
- E. Equipment List: Include each piece of equipment and include model number, manufacturer, serial number, location, and date of original installation. Insert testing record of each piece of

adjustable equipment, listing name of person testing, date of test, and description of as-left set points.

- F. Field quality-control reports.
- G. Operation and Maintenance Data: For headend and distribution system to include in emergency, operation, and maintenance manuals.
- H. Contract shall submit set of all drawings and product data to permitting agencies as required. These final design documents shall be prepared under the supervision of an engineer licensed in the state where the work is to be performed, engaged/employed by the system vendor, and must bear the engineer's licensure seal with signature and date.
- I. Any permits necessary for the installation of the work shall be obtained prior to the commencement of the work. All permit costs and inspection fees shall be included.
- J.

PART 2 - PRODUCTS

2.1 RADIO FREQUENCY (RF) BDA-BASED SIGNAL BOOSTER SYSTEMS

- A. In-building signal booster systems shall receive and re-transmit the entire uplink/downlink frequency band utilized by the regional emergency service provider(s). The contractor shall confirm with the regional emergency service provider(s) as to the specific frequencies used by the various agencies. This system shall be state-of-the-art, operating bi-directionally and in full duplex. The system shall be fully compatible with and function on Locality's Public Safety Radio System.
- B. BDA shall be capable of providing in building coverage for all the cellular networks as identified by the owner.
- C. Signal boosters (BDA)
 - 1. Shall have NEMA Type 4 enclosure
 - 2. Shall be UL2524 listed
 - 3. Shall be FCC certification.
 - 4. Provide standby battery system capable of maintaining the system operational for a minimum of 12 hours or 2 hours if supplied by emergency generator circuit. Batteries system shall be completely enclosed in NEMA Type 4 enclosure.
 - 5. Signal Boosters shall have oscillation suppression circuitry to protect the public safety radio system in case of system malfunction or other causes. The oscillation suppression circuit shall not disable the system operation. Systems that automatically disable the signal booster upon oscillation detection shall not be allowed
 - 6. Signal Boosters shall have uplink noise suppression function to eliminate uplink noise while in standby (i.e. no radio transmission from within a building).
 - 7. Include relays as required for monitoring system with fire alarm system.
- D. DAS Antennas shall be architectural, dome or flush type where located in public areas. Stick type antennas are acceptable where located in back-of-house spaces. Finish shall be white unless directed otherwise by architect in submittal review.
- E. A dedicated annunciator panel shall be provided next to the fire alarm panel / annunciator or other location as designated by AHJ to annunciate the status of all signal booster locations. The annunciator panel shall provide visual and labeled indication of the following for each signal booster:

1. Normal AC power
 2. Loss of normal AC power
 3. Battery charger failure
 4. Low-battery capacity (i.e., to 70 percent depletion)
 5. Signal source malfunction
 6. Active RF-emitting device malfunction
 7. Active system component malfunction
- F. The communications link between the dedicated annunciator and the Emergency Responder Radio Coverage (ERRC) system shall be monitored for integrity.
- G. Completed installations (including cabling) shall comply with all applicable codes and standards, including County Building and Electrical Codes, NFPA, ANSI, NEC, OSHA, EIA, IEEE, R-56, etc., as well as the FCC Rules and Regulations, as applicable. Equipment provided shall be UL listed and FCC type accepted for this specific application. Compliance to codes and standards shall extend to include proper grounding, bonding and surge.
- H. All cabling shall be plenum rated.
- 2.2 DESIGN REQUIREMENTS:
- A. The system shall provide digital signal strength coverage over 95% area on each floor/level of the equipped building, or in specific areas defined by Locality in a Scope of Work document for a particular building or site. Critical areas shall have 99% floor area coverage.
- B. Systems shall provide a minimum digital and analog coverage of Circuit Merit (CM) 3 and Delivered Audio Quality (DAQ) 3.0, with a reliability factor of 95%.
- C. Antenna isolation shall be maintained between the donor antenna and all inside antennas (D.A.S.) to a minimum of 20dB under all operating conditions
- D. A Coverage Acceptance Test shall be executed prior to final acceptance of an installed system. Coverage acceptance testing shall be based on audio quality performance in evenly spaced test grids in the defined service areas. A minimum of 20 tests will be taken per floor/level. Total number of test grids will be determined by the Owner, based on the size of the space per floor/level.
- E. Design and appearance will be of “finished” construction, i.e. shall be concealed and/or unobtrusive in finished areas. DAS antennas shall be located in back-of-house areas where possible. If required to be located in visible public areas, antennas shall be architectural, low-profile type and located in corridors where possible. Unless indicated otherwise, wire mold and surface conduit installations will not be acceptable unless approved in writing by the Architect in advance.
- 2.3 MANUFACTURER
- A. Equipment shall be as manufactured by Simplex, Notifier or EST or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Wiring shall be in strict accordance with the National Electrical Code and all state and local regulations. Wiring shall be installed in accordance with manufacturer’s wiring diagrams and shall test free from ground, opens and short circuits.

- B. All connections shall be made under the direct supervision of a qualified technician.
- C. Contractor shall provide dedicated power circuits as required for system operation. Where an emergency distribution system is provided, radio coverage system power shall be connected to the emergency branch.
- D. All vertical riser cabling shall be installed in conduit within a 2-hour fire rated enclosure.
- E. All copper circuits routed between or outside of buildings shall be provided with a surge protection device at each end.
- F. Securely mount donor antenna on roof and aim towards direction of public safety city repeater antenna. All mounting and penetrations shall be coordinated with roofing contractor.
- G. Contractor shall provide all devices and cabling as required to monitor system with building Fire Alarm System in accordance with NFPA 1225 and all other applicable code requirements. At a minimum the fire alarm system shall monitor the following:
 - 1. Signal source malfunction.
 - 2. Active RF-emitting device failure.
 - 3. Low-battery capacity indication when 70 percent of the 12-hour operating capacity has been depleted.
 - 4. Active system component failure.
 - 5. Loss of normal AC power.
 - 6. Failure of battery charger.
 - 7. The communications link between the fire alarm system and Emergency Responder Radio Coverage (ERRC) system shall be monitored for integrity.
- H. Refer to Specification Section 270500 for additional installation requirements.
- I. During initial installation, each system shall be optimized to perform in accordance with the specifications set forth in the system design, manufacturer's specifications, and FCC regulations. The contractor shall ensure that uplink and downlink levels are properly set and consistent with design expectations. The contractor shall further ensure that noise and spurious products are held within limits set forth in the system design, manufacturer's specifications, and FCC regulations. Prior to system acceptance, for each active BDA, booster amplifier, etc., the contractor shall submit a Proof of Performance certification, that lists the design expectations, actual measurements, and if applicable, FCC specifications for the following parameters:
 - 1. Worst case BDA uplink input level, in dBm.
 - 2. Worst case BDA uplink output level, in dBm.
 - 3. BDA downlink input level, in dBm.
 - 4. BDA downlink output level, in dBm.
 - 5. Noise and spurious products, BDA uplink output, in dBc.
 - 6. Noise and spurious products, BDA downlink output, in dBc.
- J. The original Proof of Performance report shall be submitted to Owner's project manager, and a copy of the Proof of Performance report shall be affixed to its associated equipment.

3.2 WARRANTY

- A. The contractor shall provide a full one-year warranty to cover installation and all equipment, software, and components; the warranty shall commence upon the Owner's final acceptance of the facility. Under warranty coverage, the successful contractor shall provide same business day response time for system malfunctions.

- B. The contractor shall perform optimization of each system during the initial warranty period, sixty (60) to ninety (90) days prior to warranty expiration. This optimization task is separate from the initial optimization performed during system installation. The contractor shall include pricing for annual system optimization to be included as part of post-warranty maintenance. Actual scope of work for annual optimization and maintenance will vary on a case-by-case basis, but typically will consist of the following:
 - 1. Optimize the system to perform in accordance with the specifications set forth in the system design, manufacturer's specifications, and FCC regulations.
 - 2. Ensure that uplink and downlink levels are properly set and are consistent with design specifications.
 - 3. Ensure that noise and spurious products are held within limits set forth in the system design, manufacturer's specifications, and FCC regulations.
- C. Update the Proof of Performance records for the system, listing the design expectations, actual measurements, and if applicable, FCC specifications for the following parameters:
 - 1. Worst case BDA uplink input level, in dBm.
 - 2. Worst case BDA uplink output level, in dBm.
 - 3. BDA downlink input level, in dBm.
 - 4. BDA downlink output level, in dBm.
 - 5. Noise and spurious products, BDA uplink output, in dBc.
 - 6. Noise and spurious products, BDA downlink output, in dBc.
- D. The updated Proof of Performance report shall be submitted to the Owner, and a copy of the updated Proof of Performance report shall be affixed to its associated equipment.
- E. Visually inspect outside antenna installation. Correct any issues found with the antenna mounting hardware, grounding system, or outside cabling.
- F. Visually inspect inside BDA or booster amplifier equipment installation. Correct any issues found with RF cabling, electrical connection, or equipment mounting.
- G. Clean equipment fans, filters and other ventilation system components.
- H. Inspect and replace any defective indicator lights.
- I. Test battery system performance for proper fallback to battery power and the duration of battery operation.
- J. Test fault reporting system for proper operation and reporting of system faults.
- K. Submit a written Preventive Maintenance Report to the Owner, listing the results of the optimization and preventive maintenance effort. The report shall include the Proof of Performance report for active RF components, and details of any other discrepancies found and corrective actions taken.
- L. All as-built drawings shall be submitted to the Owner at completion, which shall include antenna system layout and all associated hardware, along with specification sheets. Include RF measurements taken.

END OF SECTION 287800