SECTION 28 05 37
EMERGENCY RESPONDER RADIO COVERAGE SYSTEM
BASED ON DFD MASTER SPECIFICATION DATED 03/01/23

Notes to A/E:
This section has been written to cover the requirements of Emergency Responder Radio Coverage. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written.

Changes to the Wisconsin Building Code which, in turn references international codes, may impact system requirements. Confirm use of this specification master with DFD prior to document preparation.

Where Cellular Telephone coverage is to be enhanced, a separate Division 27 section shall be used. Confer with DFD for example content.

Edit all areas as applicable to meet the requirements of the project. Common options or features recognized by the DFD, or items where A/E input is needed are enclosed in [brackets] and/or <less-greater brackets>. Delete product types (PART 2) and related installation (PART 3) instructions that are not applicable to the project.

Editing instructions are included throughout the document (italic text; red if viewed/printed in color). Delete these instructions for printing.

The document is structured to automatically update the Table of Contents when printed or in response to an "Update Field" command (right mouse click on TOC opens menu) in MS-Word. Confirm that TOC has updated and is accurate of prior to printing. TOC entries are Hyperlinks and can be used to navigate the document.

Revision History:
New section.
Previously released as Section 27 53 19 – INTERNAL DISTRIBUTED ANTENNA SYSTEMS.

PART 1 - GENERAL

SCOPE
The work under this section includes all labor, material, equipment, and related design services necessary to design and install a new Emergency Responder Radio Coverage System including Donor Antenna, Processing and Amplification Equipment and passive Distributed Antenna System (DAS) . This specification provides performance criteria for the system.

Included are the following topics:

Miscellaneous Equipment
PART 3 - EXECUTION
General
Radio Frequency (RF) Survey
Installation
Identification And Labeling
Acceptance Test Procedure
Documentation / Project Record Documents
Agency Training
Warranty and Service

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Edit as applicable to match project requirements. Delete reference to sections that do not appear in the project documents. Add other sections that apply.
Note: specification Section 27 53 19 – Internal Cellular, Paging, and Antenna Systems is not yet available through DFD as a master specification and is intended for situations where cellular telephone services are to be provided in a building as well as ERRC and may include related cabling and other infrastructure. Contact DFD where this section is required.

Section 07 84 00 – Fire Stopping
Section 26 05 00 – Common Work Results for Electrical
Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
Section 26 05 26 – Grounding and Bonding for Electrical Systems
Section 26 05 29 – Hangers and Supports for Electrical Systems
Section 26 05 33 – Raceway and Boxes for Electrical Systems
Section 26 05 36 – Cable Trays for Electrical Systems
Section 26 05 53 – Identification for Electrical Systems
Section 27 05 53 – Identification for Communications Systems
Section 27 08 00 – Commissioning of Communications
Section 27 10 00 – Structured Cabling
Section 27 11 00 – Communications Equipment Room Fittings
Section 27 11 13 – Communications Protective Devices
Section 27 53 19 – Internal Cellular, Paging, and Antenna Systems
Section 28 31 00 – Fire Detection and Alarm

REGULATORY AND STANDARDS REFERENCES

All work and materials are to conform to applicable rules and requirements of :

- Wisconsin State Electrical Code (SPS 316)
- National Electrical Code (NFPA 70)
- National Fire Protection Association (NFPA 72)
- National Electrical Safety Code
- Federal Communications Commission (FCC) rules, and present manufacturing standards (including NEMA).
- NFPA 1221 – Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems
- Other applicable National Fire Protection Association codes

Applicable standards (plus applicable update bulletins and errata) include the following:

- ANSI/TIA-568-C.0, -568-C.1, -568-C.2, 568.3-D, -569-C, -606-B and ANSI-J-STD-607-B (with exception) and TIA/EIA Standards referenced therein.
- IEEE/ANSI 142-1982 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- TIA-607-C - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

- TIA TSB-88 – Wireless Communications Systems Performance in Noise and Interference-Limited Situations
- FCC 47 CFR Part 90.219.
- FCC OET 65 – Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
- UL 2524 –In-building 2-Way Emergency Radio Communication Enhancement Systems

Per the referenced TIA TSB, Delivered Audio Quality (DAQ) definitions relating to understandability of speech–to be used in acceptance testing–are as follows:

DAQ 1: Unusable. Speech audible but not understandable.
DAQ 2: Speech understandable with considerable effort. Frequent repetition required due to noise/distortion.
DAQ 3: Speech understandable with slight effort. Occasional repetition required due to noise/distortion.
DAQ 3.5: Speech understandable with repetition only rarely required. Some noise/distortion.
DAQ 4: Speech easily understood. Occasional noise/distortion.
DAQ 4.5 Speech easily understood. Infrequent noise/distortion.
DAQ 5: Speech easily understood.

DESIGN INTENT

Provide an in-building Radio Coverage System capable of transmitting all public safety radio frequencies assigned to the jurisdiction and be capable of using modulation technology in use by the municipality.

Supported frequencies include:

- [Add frequency information Here]

Assumed Municipal Radio Repeater Location: [Enter assumed location as directed by municipality]

Confirm Repeater Location with municipality prior to construction.

The system shall distribute the signal to meet performance requirements throughout the entire building or, if a more limited scope is specified, the coverage areas identified on the drawings.

For purposes of bidding, assume that the Distributed Antenna System will be required throughout the required coverage area.

Contractor shall refine the system design during construction based on the results of the RF Survey described in PART 3.

A Credit to the owner for scope reductions resulting from a test-based re-design will then be determined.

Minimum signal strength received should be specified as -95 dBmV (per Wisconsin Building Code) for Emergency Responder radio systems. If other systems are supported by the DAS, edit signal strength as applicable for that system.

The building shall have the following acceptable radio coverage in 95 percent of the identified coverage :

- Delivered Audio Quality (DAQ) of 3.0 or better
- Minimum signal strength received: -95 dBmV.

System design shall provide for signals transmitted from within the building to be received by the emergency responder radio system at a level of -100 dBmV or better.

Technical criteria: Obtain from the fire code official a document providing the specific technical information and requirements for the emergency responder radio coverage system. This document shall contain the various frequencies required, the location of radio sites, effective radiated power of the radio sites, and other supporting technical information.

Secondary power: The secondary power supply shall be capable of operating the emergency responder radio coverage system for a period of at least 24 hours. When primary power is lost, the power supply to the emergency responder radio coverage system shall automatically transfer to the secondary power supply.

Amplifiers (Signal Booster) requirements: If used, amplifiers shall meet the following requirements:

- All components shall be contained in a NEMA 4-type cabinet.
- Battery systems used for the emergency power source shall be contained in a NEMA 4-type cabinet.
- The signal booster system and battery system shall be electrically supervised by the building's fire alarm system.
- Equipment shall have FCC certification prior to installation.

Additional frequencies: The radio coverage system shall be capable of modification or expansion in the event frequency changes are required by the FCC.

QUALITY ASSURANCE

Amplification systems capable or operating on frequencies licensed by the FCC shall not be installed without prior approval of the DFD and/or fire code official.

Manufacturers shall have a minimum of five (5) years of documented experience in designing, manufacturing, delivering, and supporting the specified material.

Minimum contractor qualifications shall include the following:

- The necessary certifications to provide for Guarantees as specified herein, and
- A valid FCC-issued general radio operators license, or
- Certification of applicable system training issued by a nationally recognized organization or school, or the manufacturer of the equipment being installed.

Contractor shall have documented history of successfully providing and servicing the specified system type for a minimum of two (2) projects of a scope and magnitude of at least 50% of that specified in the Contract Documents.

Contractor shall have an in-house service department staffed with technicians who are individually manufacturer-certified to install and service specified equipment, devices, components, materials, and systems proposed and approved for use on the project, and who are equipped with tools, equipment, materials, etc. necessary to install and service specified equipment, devices, components, materials, and systems proposed and approved for use on the project.

INSPECTIONS AND PERMITS

Refer also to Division 1, General Conditions, Permits, Regulations, Utilities and Taxes.

Obtain and pay for all required state or local installation inspections and permits except those provided by the Architect/Engineer. Deliver originals of required certificates DFD Construction Representative. Include copies of the certificates and reports in the Operating and Maintenance Manuals.

SUBMITTALS

General

Under the provisions of Division 1, prior to the start of work, submit:

- Bidder Qualifications
- Schedule of Values

Prior to construction, submit:

- RF Survey results per PART 3
- System Schematic and Design Detail per PART 3.

- Shop Drawings

Prior to system tests, submit Test Plan per PART 3.

Group Submittals to include complete documentation of related systems, products and accessories in a single submittal. Where applicable, mark dimensions in units to match those specified.

Submit documents in electronic – Adobe ".pdf" – format.

The Engineer shall review the Submittals and through annotation and/or a cover sheet, provide comment.

Work shall not proceed without the Engineer's review of the submitted items.

Bidder Qualifications
Provide documentation of manufacturing history, licensing and certifications, project and staff experience, and service capabilities per the Article QUALITY ASSURANCE.

Schedule of Values
As part of the project Schedule of Values, identify amounts included in Bid for:
- RF Survey
- System Design
- DAS System Materials
- DAS System Labor (Installation, Testing, Documentation, Training, etc.)

These costs should be included in the overall project Schedule of Values to be submitted to the DFD.

Shop Drawings
Submit documents including:
- Manufacturer's Product data for all products proposed indicating construction, materials, ratings, and all other parameters identified in Part 2 (Products) below.
- Manufacturer's installation instructions.
- Samples of all label types planned for the Project. These samples shall include examples of the lettering to be used. Mount samples on 8 1/2" x 11" sheets and mark to indicate their proposed use.

Upon request by the Engineer, provide one (1) two-foot section of each cable type proposed. The manufacturer's cable markings shall be visible on the sample.

Test Plan
Submit Test Plan during construction. See Part 3.

Confirm local inspection and/or permitting requirements for the project location.

Permits
Edit to indicate Confirm local inspection and/or permitting requirements.
If no inspections or permitting apply, add "None required."

Where applicable, submit permit application and back-up documents including:
- Plans containing the riser diagram, cable paths, antenna and equipment locations.
- Equipment technical specifications.
- Product certifications (FCC ID, UL Listing and File Number).
- Battery Calculations.
- Contractor Contact Information.
- If the passive Distributed Antenna System (DAS) will have non-fire department frequencies included.

Plans shall be signed by a person holding FCC or other certification(s) identified above in Article QUALITY ASSURANCE.

WORK BY STATE AND/OR USER AGENCY
None.

COOPERATION
Cooperate with other trades and State personnel in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the work to better fit the general installation, such work shall be done at no extra cost to the State, provided such decision is reached prior to actual installation. Confirm the location of required electrical outlets before installing ERRCS

DELIVERY, STORAGE AND HANDLING
Store all materials per manufacturer's recommendations as minimum. If the contractor wishes to have a trailer on site for storage of materials, arrangements shall be made with the Owner. If necessary, materials shall be stored off site at the contractor's expense.

DRAWINGS
It shall be understood that the details and drawings provided with the bid documents are diagrammatic. They are included to show intent and to aid the Contractor in bidding the project. The Contractor shall make allowance in their bid to cover all work required to comply with the intent of the plans and specifications.

Verify all dimensions at the site and be responsible for their accuracy.

OMISSIONS
Prior to submitting the bid, the Bidder shall call the attention of the Engineer to any materials or apparatus the Bidder believes to be inadequate and to any necessary items of work omitted within ten (10) days prior to the Bid Due Date.

PART 2 - PRODUCTS

SYSTEM REQUIREMENTS
General
System shall include, but not be limited to antennas, cabling, connectors, passive and active components and hardware as required to provide a complete system performing to the criteria identified in DESIGN INTENT.

System shall:
- Be survivable from attack by fire per the referenced Codes.
- Comply with applicable sections of FCC rules and have FCC certification prior to installation.
- Be listed per UL 2524 for the intended purpose.
- Include built-in automatic supervisory and trouble alarms of malfunctions of the signal handling and battery

System components shall be contained in a NEMA-4 Enclosure.

Enclosures shall be painted RED with White or Bright Yellow labeling.

Enclosure shall be equipped with a locking mechanism.

Monitoring
System status monitoring shall include:
- Amplifier trouble
- Loss of normal AC power
- Battery Charger failure
- Low battery capacity (alarming at 70% of battery capacity and 30% of the charge remaining)
- Antenna Failure

Power

The system equipment shall be connected to separate dedicated 120V, 20A, branch circuit from the building emergency panel.

The system shall be provided with battery or uninterruptible power supply (UPS) power where active equipment is located for not less than two (2) hours operation upon loss of power. When primary power is lost, the power supply to the radio coverage system shall automatically transfer to the secondary power supply.

Generator backup power, where available, may be used for the secondary power, but the batteries and/or UPS must be capable of providing the first two hours of backup power and must ride through the power outage until the generator is able to provide the backup power.

Generator backup power, If generator backup power is not available on this project, then batteries and/or UPS units must provide the full 24 hours of secondary power. The Emergency Responder Radio Coverage System shall remain fully functional upon loss and return of power and not require a restart in any condition.

The system shall be provided with battery or uninterruptible power supply (UPS) power where active equipment is located for not less than [two (2) hours] [Twenty-four (24) hours] operation upon loss of power.

Distributed Antenna System (DAS)

The Distributed Antenna System (DAS) may utilize a radiating cable, conventional cable, fixed antennas or a combination of those cable types.

Sharing of the passive DAS with cellular or other commercial in-building radio systems is allowed only if approved by the municipality. Intermodulation study and the list of commercial frequencies shall be submitted with the permit application.

A secondary user of the DAS must comply with all requirements of the municipality so as not to degrade the operational standards of the system.

ANTENNAS

Broadband Donor Antenna

Antenna shall feature a multi-band design accommodating all applicable Public Safety frequencies in a single pole-mounted antenna.

Antenna azimuth pattern shall be as proposed by the manufacturer to meet the performance specifications of the system as installed.

Temperature range: -40°C to +60°C.

Rated for outdoor use.

Coverage Antenna - Omnidirectional

Antennas shall feature a multi-band design, accommodating multiple frequency bands in a single ceiling-mountable antenna.

Antenna beam-width:

- Horizontal: 360° omnidirectional
- Vertical: 65-80° nominal

Temperature range -40°C to +60°C.

Rated for indoor use.

Coverage Antenna - Directional
Antennas shall feature a multi-band design, accommodating multiple frequency bands in a single wall-mountable antenna.

Antenna beam-width:
- Horizontal: 110° directional
- Vertical: 90° nominal

Temperature range -40°C to +60°C.

Rated for indoor use.

BI-DIRECTIONAL AMPLIFIERS (BDA)
Where a Bi-Directional Amplifier (BDA) is used to drive a Distributed Antenna System, the BDA shall be of a modular design and use digital filtering to mitigate interference.

Unit shall be standard 19" rack or wall mountable.

Each RF amplifier shall be capable of adjusting and controlling power levels.

Units shall be IP-addressable and be monitorable/controllable via a web-based or a thick client GUI application.

Where proprietary GUI software is required, provide a licensed copy of such software for installation on an agency-owned PC. Contractor shall identify hardware requirements and, in coordination with the agency, install and configure such software.

CABLES
Cables shall be as recommended by the equipment manufacturer and shall be compatible with the installed equipment.

Cables shall be listed as required by the pathway and compatible with the environments in which they are installed.

MISCELLANEOUS EQUIPMENT
Splitters, Combiners, Couplers, Jumpers, and Connectors to be utilized with the system shall be by a manufacture recognized by the manufacturer of the major system components.

PART 3 - EXECUTION

GENERAL
Coordinate service requirements and system operation with the Authority Having Jurisdiction (AHJ).

Refer to Project Drawings which indicate equipment and donor antenna locations and major cable routes within the building.

Furnish and install all materials and equipment required for a complete and operating system.

During the construction period, coordinate schedule and operations with the User Agency, DFD Construction Representative and Owner.

Identify and report to the DFD Construction Representative and agency any existing damage to walls, flooring, tiles and furnishings in the work area prior to start of work. Repair any and all damage to interior spaces caused by the installation of cable, raceway or other hardware. Repairs must match preexisting color and finish of walls, floors and ceilings. Any contractor-damaged ceiling tiles are to be replaced by the contractor to match color, size, style and texture.

RADIO FREQUENCY (RF) SURVEY

Prior to system installation, perform an RF survey of the required coverage area. This survey shall be completed after the building shell is erected, interior walls are constructed, and exterior glass has been installed.

Survey results shall be the basis of refining the design for the new system.

Submit documentation created by RF design software showing compliance with the design criteria.

INSTALLATION

General

Beginning installation means contractor accepts existing conditions.

Install and cabling and equipment in a neat and workmanlike manner, in accordance with manufacturer's instructions and as indicated on drawings.

Support all cabling per manufacturer's recommendations raceways, cable tray, conduits, support hooks (e.g. J-hooks), etc..

Minimum separation distances between communications wires and cables, and any electric light, power, Class 1, non-powered fire alarm, or medium power network-powered broadband communications circuit shall comply with NEC Article 800.

Cable other than ERRCS cable is allowed to comingle with the ERRCS cable in the conduit provided it is listed, shielded cable that will not interfere with ERRCS operation.

Bond to ground all cables connecting hardware, active equipment, outdoor antennas and mounting structure per manufacturer's recommendations or as detailed herein and on the project drawings.

Pathways

Provide pathway (circuit) survivability in accordance with 2016 NFPA 1221.

Raceway for Backbone Cable shall be two-inch (trade-size) minimum.

Backbone Cables shall be routed through a 2-hour-rated enclosure or be 2-hour-rated cable.

Route and install pathways and cabling to provide ready access to backbone and distribution cabling for service and inspection.

Donor Antennas

Coordinate donor antenna exact locations and mounting method with Agency prior to rough-in.

Donor antenna assemblies including, but not limited to, antenna(s), antenna cable, antenna mount/mast, and all associated accessories and hardware shall be designed and installed to withstand sustained winds of ≥100 miles per hour from any direction with all devices, equipment, and material installed and with up to 1 inch of radial ice accumulated. Fasten all donor antennas and associated masts/mounts, etc. with stainless steel fasteners exclusively.

Provide Surge Protection on all outdoor antenna downleads per specification Section 27 11 13.

Weatherproof all exterior antenna cable connections with manufacturer-approved sealing compound.

Grounding

Provide at each Donor Antenna an exterior dielectric enclosure in which ground busbar and surge arrestor are mounted. Bond Busbar to Ground Distribution System

Make all donor antenna mounts/masts and associated components, accessories, and hardware electrically continuous and bond to ground.

Bond to an approved ground antenna downleads (cable shield) at the antenna and where the cables enter the building.

Bond Surge Protection to ground per specification Section 27 11 13

Equipment

Coordinate exact locations of all system equipment in existing telecom rooms with User Agency prior to rough-in.

Mount head-end equipment in an equipment rack or on-wall as shown on the drawings.

Bond all equipment to an approved ground per the manufacturer's recommendations.

Coordinate with Division 26 to provide 120-volt operating power at equipment as needed.

Coverage Antennas

Install coverage antennas above accessible ceilings, mounted to the bottom of structure. Coordinate all antenna locations with work by other trades to ensure that direct access to each antenna is maintained after completion of project.

Coaxial feeder cables between tap on backbone cable and coverage antenna shall be as short as possible to reduce attenuation. Support cables longer than one meter by J-hooks or mounted cable tray.

Protection of Cable and Antennas from Foreign Materials:

Provide adequate physical protection during construction to prevent foreign material application or contact with cables and antennas.

Refer to specification Section 27 10 00 for additional information.

IDENTIFICATION AND LABELING

Refer to Section 27 05 53 "Identification for Communications Systems" for general Identification and Labeling guidelines.

Label all equipment, cabling and termination components.

Label each Distribution Antenna with a unique alpha/numeric identifier. Coordinate plan with agency.

Label main equipment cabinet with contractor and service vendor contact information. Service Vendor information shall include local or toll-free telephone number to call for service or repair of the installed system.

Prior to installation, provide samples of all label types planned for the project. These samples shall include examples of the lettering to be used.

ACCEPTANCE TEST PROCEDURE

General

Upon completion of the installation, test the radio system to ensure that two-way coverage complies with the requirements of the project DESIGN INTENT and products part.

Acceptance Test measurements shall occur after the building shell is erected, interior walls are constructed, and all windows have been installed.

Prior to acceptance testing, provide a summary of the proposed test plan for the system, including any sub-system or cable tests. Identify equipment to be used, set-up, test frequencies or wavelengths, results format, etc. Failure to provide the above information shall be grounds for the rejection of any and all documentation of related testing and to require a repeat of the affected test(s).

Conduct acceptance testing according to a schedule coordinated with the Agency, DFD and the Fire Code Official. Provide a minimum of two (2) weeks advance notice to allow for participation by project stakeholders.

All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radio telephone Operator License, or a technician certification issued by the Association of Public-Safety Communications Officials International (APCO) or equivalent as determined by the local fire code official.

Testing shall include–but not be limited to–the following:

- Cable Sweep Test (loss, return loss).
- Coverage / Signal Strength. See the "Receive Signal Levels" paragraph below.
- Check all active components to verify operation within the manufacturer's specifications. Document any system settings such as Amplifier Gain required for maintenance.
- Test Batteries and Power Supplies under load for a period of one hour (minimum) to verify that they will operate properly during an actual power outage. If within the 1-hour test period the battery exhibits symptoms of failure, the test shall be extended for additional 1-hour periods until the integrity of the battery can be determined.
- Fire Alarm Annunciator Panel (FAAP) notification of ERRCS amplifier failure points

Receive Signal Level and Delivered Audio Quality (DAQ)

General

Conduct the tests using calibrated test equipment and/or portable radio like that used by the Agency and/or Emergency Responder and tuned to the applicable frequencies. Coordinate with AHJ _____

The test radio shall be enabled to verify two-way communications to and from the outside of the building through the public agency's radio communications system.

Perform measurements with the antenna of the receiving radio held in a vertical position at 3 to 4 feet above the floor to simulate a typical portable radio worn on the belt or turnout coat pocket.

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Area Coverage / Signal Strength

Perform tests as follows:

- Provide small scale drawings (11 x 17 inch) of the project site. Divide each floor of the building into a grid of at least 20 test areas approximately equal in size. Grid areas shall be no less than 75-feet square.
- Select test location in the approximate center of each test area with each test location no less than 20 feet nor greater than 75 feet from an adjacent test location.
- Once a test location has been selected, that location shall represent the entire test area. Failure in the selected test location shall be considered failure of that test area. Additional test locations shall not be permitted.

Record for each Test Area (of the grid), the DAQ and Signal Level results.

Performance Requirements / Test Limits:

- A DAQ level below 3.0 or a Signal Level less than the level specified the PART 1 article DESIGN INTENT shall be considered a failed test for a given grid test area.

- Failure of a three or more nonadjacent test areas shall be considered a failure of the test.

- If three or more of the test areas fail, in order to be more statistically accurate, the floor shall be permitted to be divided into 40 equal test areas. Failure of more than four nonadjacent test areas shall

be considered a failure of the test. If the system fails the 40-area test, the system shall be altered to meet the 90 percent coverage requirement. Repeat testing.

Antenna Transmit Levels

Measure signal strength at each antenna location.

Record transmit level for each antenna. Identify by location and Antenna ID.

DOCUMENTATION / PROJECT RECORD DOCUMENTS

General

Submit record documents under the provisions of Division 1, Specification Section 26 05 00, and PART 3 of this section.

Upon completion of the installation, provide project documentation for review. Documentation shall include the items detailed in the sub-sections below.

Submit documentation in electronic form for review and distribution.

Where documentation provided in electronic form requires proprietary software (e.g. NATIVE formats) for viewing test results, provide one (1) copy of such software. The software shall run on a MICROSOFT *Windows*-based personal computer supplied by the Owner. Software shall include license if applicable.

Organize documentation by category, test type, etc.

Provide approved test results, drawings and other documentation in Operating and Maintenance Manuals per DFD Policy.

Provide Plans and Schematic drawings in Adobe Acrobat (.pdf) format

Where such documents are developed using CAD, also provide the AutoCAD (.dwg) files.

All documentation, including hard copy and electronic forms shall become the property of the State.

Certification

Submit statement signed by certified installing contractor confirming that:

- The system was installed and tested in accordance with the requirements of the specification and requirements of the municipality.
- A Service Agreement as described below in Article WARRANTY AND SERVICE is in effect.

Test Results and System Settings

Provide test results–including a description of the conduct of the tests, test date, the equipment used and the procedures followed–and system setting as required for confirmation of specification compliance and for maintenance.

Document gain values of all amplifiers so that the measurements can be verified during follow-up annual tests. (Follow-up testing is not part of the contractor responsibility.)

Document RF plotting (grid tests) results.

At the request of the Engineer, provide copies of the original test results.

Submit Documentation within ten (10) working days of the completion of each testing phase (e.g. subsystem, area of building, etc.).

Interim documentation on a shorter schedule may be required to accommodate occupancy or other requirements. Confirm requirements during construction.

When such interim documentation is submitted, submit a composite results package containing all records at closeout.

Record Drawings (As-Built)

Provide Record Drawings – Plan and Schematic – which denote as-built information.

On Plan drawings, identify cable routes and locations of BDA(s), Donor Antenna(s), Distribution Antennas (with ID) and Splitter/Taps.

On Schematic drawings, show BDA settings, Splitter/Tap values, cable lengths, antenna (numbered), surge arrestor, power, grounding, alarm wiring, etc.

Identify each drawing submitted by the Contractor as part of the Project Documentation as a Record Drawings (RD) and include a) the contractor name and/or logo, and b) the date of the drawing.

Machine generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase.

AGENCY TRAINING

Provide training to DFD, Agency and site staff, and/or contract maintenance personnel on an overview of the system and on operation and maintenance of equipment installed by the contractor.

Coordinate with DFD Construction Representative, Agency and site staff, and Engineer to schedule session(s). Provide adequate notification to allow Agency to schedule staff.

Instructor(s) shall be factory authorized representative(s) and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components installed.

Provide systems demonstration and instructions. Conduct walking tour of project and describe function, operation, and maintenance of each component. Use submitted operation and maintenance manual as reference during demonstration and training.

Training to include:

- Overview of System Topology and General Concepts
- Overview of Product Used
- Overview of Maintenance and Configuration Procedures
- Overview of Labeling Formats
- Overview of Test Results and their meaning

Training shall be held at Project Site and shall be conducted during normal working hours.

Discuss number of Training Sessions with Agency to accommodate staff schedules.

For purposes of bidding, assume [(#)] Training Session(s). Coordinate training with Agency to accommodate staff schedules.

Training session duration shall be not less than two (2) hours.

Number of Students per session shall be (6) or less.

Provide training materials for each student plus (2) additional copies.

Owner reserves the right to videotape session(s) for use as future refresher materials for User Agency technical staff.

WARRANTY AND SERVICE

General

See Division 1, GENERAL CONDITIONS, and GENERAL REQUIREMENTS - Guarantee Documents for general requirements.

Warranties shall include all labor, material, and travel time.

Provide during the warranty period 24-hour by 7-day acknowledgement via telephone of service calls within one hour of notification and on-site response within 24 hours of telephone acknowledgement. This Service Agreement shall be by an authorized service provider for the installed equipment.

Submit to the User Agency, a list of services–including maintenance contracts and annual testing options–available for the installed system after the expiration of the warranty period. Such maintenance contracts and/or testing are the responsibility of the user agency and are not included in work covered under this section.

Provide and maintain a list of contact personnel–including phone numbers–at the system equipment location(s). The contact personnel shall have knowledge of the building and the radio coverage system and be available to respond to the building in the case of a radio coverage system emergency.

Follow-up Service

During the warranty period -but no earlier than 6-month after substantial completion of the project –provide at no additional cost one (1) on-site diagnostic/adjustment service to the installed system(s) to re-confirm operation, settings, etc. This service visit shall be made on a weekday during normal working hours.

Check all active components of the in-building radio system, including but not limited to:

- Amplifier(s) to ensure that the gain is the same as it was upon initial installation and acceptance. Document the original gain and any change in gain.
- Back-up batteries and power supplies. Test under load to verify that they will operate during an actual power outage.
- Other Active components to determine that they are operating within the manufacturer's specifications for their intended purpose.

Documentation results to agency and municipality.

END OF SECTION