Travis County ESD No. 12
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EMERGENCY RESPONDER RADIO COVERAGE SYSTEMS

All buildings within the jurisdiction of Travis County ESD No. 12 shall have approved radio coverage for emergency responders within the building based upon the existing coverage levels of the Greater Austin/Travis Regional Radio System (GATRRS) at the exterior of the building. If it is found that a building does not meet the minimum required coverage, steps shall be taken to ensure sufficient radio coverage is provided for emergency responders throughout the life of the building, whether the building is new or existing.

The installation of an emergency responder radio coverage system (ERRCS) shall comply with the most current editions of the International Fire Code, NFPA 1221, NFPA 72, and local adopted standards. If relevant codes address the same issue, the more restrictive code application shall apply.

The intent of this document is to provide the Travis County ESD No. 12 interpretation of the minimum standards necessary to meet the requirements for emergency responder radio coverage systems in accordance with all applicable codes and standards.

RF SURVEY

The initial step in the process is to determine radio coverage levels. To determine radio coverage levels in a building, a specialized FCC GROL technician will be required to perform a RF survey.

A RF survey is required if a newly constructed building meets any one of the following conditions:

- The new building is of Type I, II or III construction
- There are more than 3-stories above grade plane
- The total building area is 50,000 square feet or greater
- The building has a total basement area of 10,000 square feet or greater
- Any basement or level that extends 2 or more stories below grade plane
- The building is 20,000 square feet or greater and is equipped with a solar photovoltaic system
- The building is LEED (green building) certified or is equipped with Low-E glass
- Existing buildings undergoing extensive remodel and/or expansion or changing use shall coordinate with Travis County ESD No. 12 to determine if the installation of an in-building emergency responder radio system survey and potential radio coverage system is needed.

An RF survey is not required for:

- Existing buildings or structures that demonstrate sufficient radio coverage
- Elevators
- Structures that are three stories or less without subterranean storage or parking and do not exceed 50,000 square feet on any single story
- Wood-constructed residential structures four stories or less without subterranean storage or parking which are not built integral to an above ground multi-story parking structure
- In construction that is three stories or less and does not exceed 50,000 square feet on any single story but **DOES** include subterranean storage or parking, then **this requirement shall apply only to the subterranean areas**.
- R-3 occupancies, which includes lodging houses, congregate residences, and large family day care homes with no more than 16 occupants

If a building's conditions fall into both the aforementioned categories, the building will require a RF survey. For example, a four-story wood frame residential structure that has a total building area of 50,000 square feet or greater will require a RF survey.

When the building is closed in (after completion of the building envelope), the initial RF survey and clarity study shall be performed. Completion of the building envelope includes, but is not limited to, the installation of all windows, interior walls, exterior openings, and the roof.

In buildings with significant internal signal impairments such as rack storage, security screens or other interior or exterior features, all internal construction shall be complete prior to a RF survey.

At a minimum, RF surveys shall include:

- Date of survey
- Specific code requirements referenced
- Size and number of equal grids used for the survey
- Location where the radio frequency strength was taken in each grid
- RSSI (Received Signal Strength Indicator)
- Minimum acceptable coverage requirements for non-critical and critical areas used in survey
- Any additional measurements taken in "critical areas"
- The number of grids allowed to fail per floor
- Results of the current grid test illustrating that all areas passed the coverage area requirements
- Specific control channel used for survey
- Building conditions at time of testing
- Location in relation to the nearest tower
- Type of testing equipment used
- Proof of current calibration of the testing equipment within 12-months of test date
- Recommendations based on the radio signal strength coverage

The RF survey results shall be submitted to Travis County ESD No. 12 as part of the initial RF survey results. Travis County ESD No. 12 will review the submitted documents and the recommendations from the results of the RF survey and clarity study. Travis County ESD No. 12 may require a licensed third party to evaluate the results of the RF survey should the conditions warrant additional review.

If the RF survey demonstrates compliance with all applicable codes and requirements, the FCC GROL technician who completed the survey shall provide a statement of sufficient radio coverage to Travis County ESD No. 12.

If the RF survey determines an emergency responder radio coverage system is necessary, a construction permit for the installation of the system shall be obtained from Travis County ESD No. 12.

PERMIT AND PLAN REQUIREMENTS

NOTE: Failure to provide any of the following information in the permit and plan requirements section will result in the plan being disapproved.

MINIMUM RF SURVEY INFORMATION REQUIRED FOR PERMIT ISSUANCE

- Initial survey results
- Recommendations based on the radio signal strength coverage
- Equipment listing and spec sheets
- Design plan
- Location of all critical areas
- Link budget
- Heat maps/projections
- Secondary (backup) power systems with calculations included
- Acknowledgement of post-installation RF survey and clarity study to be completed at conclusion of installation

MINIMUM REQUIRED PLAN INFORMATION FOR PERMIT ISSUANCE

The plan and all attachments provided to Travis County ESD No. 12 shall be clearly labeled and legible.

All pages of the plan submittal shall be numbered.

The plan and all revisions to the plan shall be dated. If the plan requires a resubmittal, all areas where corrections have been made shall be marked and clouded with a delta.

If making changes to an existing system, all existing devices and equipment shall be shown and properly identified on the floor plan and system riser diagram.

The plan shall include 1) a cover sheet, 2) an equipment list, 3) a floor plan, 4) a system riser diagram, and 5) secondary (backup) power information/calculations.

COVER SHEET

Provide the following information on the cover sheet:

- Project name and address
- The designer's full name, FCC License number and signature. The designer of record is responsible for the entire system being worked on.
- Business name, address, and FCC issued License of the installing contractor. If the designer of the system is not the installing contractor, the following shall be clearly delineated on the plans:
  DESIGNED BY - followed by the designer's business name, address, designer of record's full name and signature
  INSTALLING CONTRACTOR - followed by the installing contractor's business name, and address
- Type of supervising station service as per NFPA 72
- Occupancy type(s) of building or area as defined by the International Fire Code
- Number of stories below grade, number of stories above grade, building height, total building area, and building construction type
- Scope of work
- Indication of what type of system is being installed
- Description of transmission zone assignments
- A note stating that the design and installation complies with the most current editions of NFPA 72, NFPA 1221, NFPA 70 (NEC), International Building Code, International Fire Code and all local adopted standards
- Vicinity map
- All other pertinent notes
- A layout of the building and/or complex indicating the street location and the area of work within the building

EQUIPMENT LIST

- Provide the model number, manufacturer's name, description, quantity, and symbols to be used (legend) for each device, equipment, and conductors proposed to be installed.
- Symbols used on the plans shall match the legend. Remove any "typical" symbols that do not pertain to the installation.

FLOOR PLAN

- Scale used and a graphical representation of the scale
- Room and room names
- The locations of partitions, non-rated walls, and rated walls
- The location of all emergency responder radio coverage equipment
- Power and panel locations
- Raceway routing
- Conduit and conductor size
- Roof plan showing location(s) of antennae
- Location(s) of in-building antennae
- Band width

RISER DIAGRAM

- Single-line wiring diagram (riser diagram) that shows the interconnection of equipment of the whole system
- Type and size of wire or conductor to be used
- Schematic drawing of electrical system and secondary (backup) power
- Detail Diagram – show supervisory points from repeater

SECONDARY (BACKUP) POWER INFORMATION/CALCULATIONS

- Secondary (backup) power calculation
- Signal propagation map – color map indicating the signal strengths as designed and then as installed by As-Built.

ATTACHMENTS

- Manufacturer's specification sheets for all devices, equipment, and materials to be used shall be provided. Highlight on the cut sheet which device or equipment is being used, the listing information, and the application.

Once Travis County ESD No. 12 reviews the submittal and issues a construction permit based on the information provided, the installation, initial dummy load testing, and live acceptance testing can be completed.

After installation is complete, the installing contractor shall perform a post-install RF survey and clarity study. The final testing documentation, including any as-builts, shall be submitted to Travis County ESD No. 12.

The building owner shall obtain the annual operating permit based on annual third-party testing to ensure coverage levels have not been negatively affected. The third-party testing agency shall provide coverage verification to Travis County ESD No. 12.

SIGNAL STRENGTH

A minimum signal strength of **-95dBm** shall be provided into the building. A minimum signal strength of **-95 dBm** shall be received by the radio system when transmitting from within the building.

General areas, shall be provided with **95 percent floor area radio reliability coverage**, measured at the input of the receiver as worn and operated during typical fire and rescue operations.

Critical areas, such as fire command center(s), fire pump room(s), sprinkler riser room, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical shall be provided with **99 percent floor area radio reliability coverage**.

There shall not be any excessive leakage outside of the building. Outside of the building at any point 20 feet from the outside wall of the structure, signal levels from the BDA shall not exceed -115dBm.

Exception: Interior courtyards that may have open air access but are surrounded by the building itself.

If a donor antenna exists, isolation shall be maintained between the donor antenna and all inside antennas and shall be a minimum of 15dB above the signal booster gain under all operating conditions.

The inbound and outbound signals shall be sufficient to provide a **minimum of DAQ 3.0** for either analog or digital signals.

Delivered Audio Quality Metrics:

- DAQ 1 Unusable. Speech present but not understandable.
- DAQ 2 Speech understandable with considerable effort. Need frequent repetition due to noise/distortion.
- DAQ 3.0 Speech understandable with slight effort. Requires occasional repetition due to noise/distortion.
- DAQ 3.4 Speech understandable without repetition. Some noise/distortion present.
- DAQ 4 Speech easily understood. Occasional noise/distortion present.

NON-INTERFERENCE

No sharing of common passive infrastructure with cellular DAS may occur.

The ERRCS shall not be infringed on, be overrun by, or combined with other radio systems such as cellular network signal amplifiers or adjacent building communication systems.

The building manager/owner shall suspend and immediately correct any other equipment installation(s) that degrade the performance of the public safety radio system or the public safety radio enhancement system.

FREQUENCIES

Travis County ESD No. 12 operates in the 800 MHz band. For the current published list of all inbound/outbound frequencies, the installing contractor shall coordinate with the Greater Austin/Travis Region Radio System (GATRRS). The ERRCS shall be capable of transmitting all radio frequencies as required by Travis County ESD No. 12 and be capable of using any modulation technology in current use by the emergency response and public safety agencies in the jurisdiction.

FREQUENCY CHANGES

Frequencies used by agencies on the GATRRS system may change as a result of an FCC order or other operational requirements of Travis County ESD No. 12 or cooperating agencies.

The ERRCS shall be upgradeable to allow for instances where the jurisdiction changes or adds system frequencies to maintain radio system coverage as it was originally designed.

The building owner shall modify or expand the emergency responder radio system coverage at their expense. Prior approval of an ERRCS on previous frequencies does not exempt this requirement.

DESIGN AND INSTALLATION COMPONENTS

The intent of the ERRCS is to provide signal amplification on every floor of the building. During installation, infrastructure (equipment space, electrical power, and cable pathways) shall be installed throughout the building. However, amplification only needs to be installed on floors that fail to pass the initial RF survey (original signal strength test) and/or final acceptance tests.

Components used in the installation of the ERRCS, such as repeaters, transmitters, receivers, signal boosters, cabling, and fiber-distributed antenna systems, shall be tested for compatibility with the public safety radio system.

The ERRCS shall permit the simultaneous use and interoperability of analog and digital radios.

The ERRCS shall be a neutral host and non-proprietary.

The antenna shall be directed to the nearest system repeater site.

Permanent external filters and attachments shall not be permitted.

LOCATION AND EQUIPMENT ROOM REQUIREMENTS

The room housing the ERRCS and all related equipment, shall be separated from the remainder of the building by 2-hour rated room on the main floor in a location approved by Travis County ESD No. 12.

The room housing the ERRCS and all related equipment shall be provided with adequate environmental controls required by the product manufacturer to maintain the room above 40 degrees Fahrenheit and a maximum temperature of 80 degrees Fahrenheit.

The ERRCS and secondary (backup) power shall be:

- wall mounted side by side or in close proximity.
- located in a NEMA 4 or NEMA 4X-type sealed enclosure which must protect it from smoke, water, and fire damage.

SIGNALBOOSTERS (ALSO KNOWN AS BI-DIRECTIONAL AMPLIFIER OR BDA)

Signal boosters shall be **Class A** in the jurisdiction of Travis County ESD No. 12. Class A signal boosters are sometimes referred to as “channelized”. Class A signal boosters and components can reduce unwanted signal amplifications and minimize potential future issues with the network.

BACKBONE AND DISTRIBUTION CABLES

A backbone having a minimum two-hour fire resistive rating shall be installed between the first floor or the bottom subterranean floor to the roof.

At each floor and the roof, an opening shall be made to allow easy access to the conduit from the ceiling. Access in either the form of a drop ceiling or access panel shall be made along hallways and through firewalls. All floors of subterranean parking garages shall have a similar conduit installation and access.

Backbone cables shall be:

- protected by a 2-hour fire-resistive rated enclosure.
- fiber-optic, copper, or coaxial cable.
- connected to the antenna distribution, radiating, or copper cables using coupler devices of a value determined by the overall design.
- plenum rated.

All connections between the backbone and distribution antenna cables shall be made within the 2-hour-rated enclosure. Passage of the feeder cable in and out of the 2-hour rated enclosure shall be fire stopped to 2-hour ratings.

Cable other than backbone or distribution cable is allowed to comingle with the backbone and distribution cable in the conduit provided it is listed, shielded cable that will not interfere with the backbone or distribution cable.

POWER SOURCES

At least 2 independent and reliable power sources, one primary and one secondary, shall be provided for all RF-emitting devices and any other active electronic components of the system.

The primary power source shall be supplied from a dedicated branch circuit and comply with the most current edition of NFPA 72.

All electrical breakers for the ERRCS shall be colored RED, marked BDA and have a mechanical lock-out device to prevent inadvertent disruption of the power.

In the event of a fault or failure of the primary power supply, the ERRCS system shall automatically and immediately transfer to a secondary power source, while constantly maintaining all required ERRCS functions and operations.

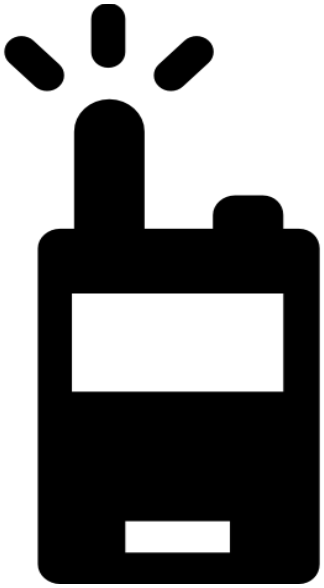
One of the following secondary power sources can be used:

- A storage battery dedicated to the system capable of supplying at least 12-hours at 100% system operation capacity
- An alternative power source (ex. automatic-starting engine driven emergency generator) serving the dedicated branch circuit or the system with at least 12-hours of 100% system operation capacity.
- In addition to the generator, the ERRCS shall be provided with a primary battery backup unit of no less than two hours of full system run-time, which shall ensure continuous coverage until the engine driven emergency generator starts.

LABELING

Buildings equipped with an emergency responder radio coverage system shall be identified by an approved sign located above or near the Knox Box stating the following: **EMERGENCY RESPONDER RADIO SYSTEM INSTALLED**.

6”x8” Metal backed sign
½” lettering
2’x4” Graphic
Red background with Blue
Reflective Letters and Graphic



EMERGENCY RESPONDER RADIO SYSTEM INSTALLED

Provide a sign on all doors providing access to ERRCS stating the following: **EMERGENCY RESPONDER RADIO COVERAGE SYSTEM EQUIPMENT INSIDE**.

Provide a sign on donor antennas stating the following: **EMERGENCY RESPONDER RADIO COVERAGE SYSTEM**. In addition, provide the service provider name and contact number on the sign for the donor antennas.

MONITORING REQUIREMENTS

A dedicated monitoring panel shall be provided to annunciate the status of the following items and all RF emitting devices. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:

- Normal 120VAC power
- Signal booster trouble
- Loss of normal 120VAC power
- Battery power fail
- Low battery capacity

The occurrence of any fault in the ERRCS where the system function is decreased shall cause a supervisory signal at an off-site monitoring service company.

The alarm point shall indicate what floor the BDA system is located. For example, an alarm with a BDA on the 5th floor would read as "5th Floor BDA AC Power Fail".

The communications link between the fire alarm system and ERRCS shall be monitored for integrity. All monitoring of system components shall relay a signal within 3 minutes 20 seconds.

POST-INSTALLATION ACCEPTANCE TESTING

The two primary considerations for the post-installation acceptance tests are:

- Equipment Validation (before it is placed on the air)
- Coverage Validation (to document the improved coverage)

Upon completion of installation, the installing contractor shall verify that two-way coverage on each floor of the building meets the minimum required levels.

The installing contractor shall coordinate with Travis County ESD No. 12 prior to the post-installation acceptance test. A representative from Travis County ESD No. 12 may request to witness the test.

ACCEPTANCE TESTING RECOMMENDATIONS

Necessary coordination shall be made such that representatives of other contractors whose equipment are involved in the testing are present.

There shall be sufficient personnel and equipment to demonstrate the installation.

The post-installation acceptance/coverage test shall be performed while on battery back-up.

During the acceptance test, the following shall be verified:

- Equipment placement
- Donor antenna
    - Verify the mount
    - Weather proofing on donor connection
    - Verify alignment with donor location
    - Grounding of the donor antenna
    - BDA location
    - Demonstrate isolation
    - BDA gain settings
    - Battery back-up units

Signal levels/signal strength must be measured with a calibrated spectrum analyzer in each of the grid cells in addition to all critical areas. Signal levels shall be demonstrated within and outside of the building. These measurements shall be imported into the same computer program utilized to generate the design heat maps.

A spot located approximately in the center of a grid area shall be selected for the test.

Once the spot has been selected, prospecting for a better spot within the grid area shall not be permitted. Each grid area shall be tested for transmission/reception at the minimum signal strength of -95 dBm. If the signal strength fails to meet the requirement, the grid area shall be marked as failing.

Measurements shall be made with the antenna held in a vertical position at three (3) to four (4) feet above the floor to simulate a portable radio worn on the belt or in a turnout coat pocket.

No more than two (2) non-adjacent cells can fail the test.

Failure in a critical area means the building fails.

Both inbound and outbound signals shall be measured on each and every floor above and below ground including stairwells, basements, penthouse facilities and parking areas of the structure.

The gain values of all amplifiers shall be measured and the test measurement results shall be kept on file at the facility so that the measurements can be verified each year during the annual tests. In the event that the measurement results become lost, the building owner will be required to rerun the acceptance test to reestablish the gain values.

The alarm monitoring company shall certify that they have received the BDA alarms as a trouble and have procedures in place to report trouble events to the proper authority.

The following acceptance test documentation shall be provided to **Travis County ESD No. 12**:

- Completed post-install coverage testing results, including as-built heatmaps showing actual signal strength measured within the building,
- FCC registration number
- As-builts showing all equipment locations
- System summary
    - BDA serial number
    - Current gain settings uplink and downlink
    - Donor location in regard to Macro site
    - Other pertinent information regarding components and system details

- Diagrams showing equipment placement and routing for antennas, coaxial cables, and AC power
- Equipment calibration certificates dated within the past 12 months
- Secondary power calculations
- List of assigned frequencies

Without the presence of the above documentation, the acceptance test shall not be approved by Travis County ESD No. 12.

After final completion and acceptance of the project, the contractor shall provide the following to the **owner**:

- Documents demonstrating compliance with all applicable codes
- All literature and instructions provided by the manufacturers describing proper operation and maintenance of all devices and equipment
- A small-scale copy of the approved plan (11”x17” maximum) and as-builts, if applicable
- A copy of a Certificate of Completion
- One set of ERRCS technical information and documentation to be filed in a secure location on site

After final completion and acceptance of the project, the building owner shall maintain the following on site:

- Documents demonstrating compliance with all applicable codes
- All literature and instructions provided by the manufacturers describing proper operation and maintenance of all devices and equipment
- A copy of the as-built plan
- Summary drawing showing locations of ERRCS headend and node equipment, and antenna sites
- Summary of ERRCS frequencies utilized
- Table of effective radiated power at antenna sites
- Keys to radio equipment room in key box
- A copy of the Certificate of Completion
- The names and contact information of personnel to be contacted at any time for access to the equipment

ANNUAL TESTING

The Emergency Responder Radio Coverage System (ERRCS) shall be inspected and tested annually or when structural changes occur including additions or remodels that could materially change the original field performance tests. This test will verify operation of all active and functioning components of the ERRCS:

- In-building coverage test (grid testing)
- Signal boosters shall be tested to verify that the gain/output power is the same as it was upon initial installation and acceptance. Any change in the gain shall be documented.

Amplifiers shall be tested to ensure that the gain is the same as it was upon initial installation and acceptance.

Backup batteries and power supplies shall be tested under load of a period of 1 hour to verify that they will properly operate 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.

Sweep test the donor antenna feed line to identify any adverse changes in the antenna system before service is impacted.

Other active components shall be checked to verify operation within the manufacturer's specifications for the intended purpose.

At the conclusion of the testing, a verification of compliance report shall be submitted to Travis County ESD No. 12.

MANUALS, SPECIAL TOOLS, AND SPARE PARTS

The building owner shall maintain an instruction manual for all components of the ERRCS.

The manual shall consist of:

- A detailed explanation of the operation of the system.
- Instructions for routine maintenance.
- An illustrated parts list and part numbers.
- Illustrated and schematic drawings of components, including operating and safety devices, control panels, instrumentation, and annunciators.

Any special tool(s) and testing devices required for routine maintenance shall be available for use when needed.

The owner of any building or structure to which this guideline applies shall be responsible for all costs associated with the installation, maintenance, testing and compliance and potential future modification with the most current Greater Austin/Travis Regional Radio System.

The information provided in this document delineates the minimum requirements for ERRCS as interpreted by Travis County ESD No. 12. It is the responsibility of the designer and installing contractor to include any pertinent information not mentioned above. For any questions, please contact TCESD No. 12 at FirePrevention@tcesd12.com or (512) 272-4502.