TECHNICAL BULLETIN
FIRE 5-1
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Emergency Responder Radio Coverage Systems

This Technical Bulletin provides guidelines for compliance with the requirements in Section 510 of the California Fire Code (CFC) and Section 918 of the California Building Code (CBC) for emergency responder radio coverage systems (ERRCSs). In addition, these systems shall be designed and installed per National Fire Protection Association (NFPA) Standard 1221 and the California Electrical Code (CEC).

I. Where Required?

A. New Buildings
All new buildings and structures are required to comply with this Technical Bulletin except for the following:

1. Group R-3 occupancies (single-family homes, duplexes and townhomes) as defined by the CBC.
2. Open parking garages with no subterranean portions.
3. Buildings or structures that are five (5) stories or less, with a floor area not exceeding 50,000 sq. ft. per floor and that do not have subterranean levels.
4. Buildings or structures that are primarily constructed of wood and do not have subterranean storage or parking.

B. Existing Buildings
Existing buildings must comply with this technical bulletin's requirements if a previously required two-way wired fire department communication system is removed.

II. Submitting for Building Permit

A. Architectural Drawings

The following notes must be added to the architectural drawings for buildings required to meet the requirements for emergency responder radio coverage as listed above:

1. This project is required to meet the requirements in CFC Section 510 for Emergency Responder Radio Coverage.
2. If this building does not meet the signal strength requirement in 95% of all areas on each floor of the building, then an approved ERRCS will be provided to achieve the required coverage.

B. Fire Alarm Plans

If two-way communication is not provided for a building because an ERRCS is proposed, then provide notes on fire alarm plans stating that emergency responder radio coverage is provided in lieu of two-way communication.

C. Electrical Plans

The electrical plans must include an approved secondary source of power required for the emergency responder radio coverage system as specified below.

III. Design of Radio Coverage System

A. Signal Strength

Acceptable ERRCS coverage requires signal strength measurements in 95% of all areas on each floor of the building, meeting the following:

1. **Minimum Signal Strength Into the Building**. The minimum inbound signal strength shall provide usable voice communications throughout the coverage area. Inbound signal level shall provide not less than a Delivered Audio Quality (DAQ) of 3.0 or an equivalent Signal-to-Interference-Plus Noise Ratio (SINR) applicable to the technology for either analog or digital signals.
2. **Minimum Signal Strength Out of the Building.** The minimum outbound signal strength shall provide usable voice communications throughout the coverage area. Outbound signal level shall provide not less than a DAQ of 3.0 or an equivalent SINR applicable to the technology for either analog or digital signals.
3. **System Performance.** Signal strength shall meet the requirements of the applications being utilized by public safety for emergency operations through the coverage area.

B. Amplification Systems and Components

Buildings that cannot support the required level of radio coverage must be equipped with systems and components to enhance the public safety radio signals and achieve the required level of radio coverage in Section III Part A. Before installation, all RF-emitting devices shall have the Federal Communications Commission (FCC) certification and be suitable for public safety use.

C. Primary Power

A dedicated branch circuit shall supply the primary power source. The location of the branch circuit disconnecting means shall be permanently identified at all equipment supplied by the dedicated branch circuit. The system circuit disconnecting means shall be permanently identified as "EMERGENCY COMMUNICATIONS" and have a red marking. Where a circuit breaker is the disconnecting means, an approved breaker locking device shall be installed.

D. Standby Power

ERRCSs shall be provided with dedicated standby batteries or provided with 2-hour standby batteries and connected to the facility generator power system per CFC Section 1203. The standby power supply shall be capable of operating the ERRCS at 100% system capacity for a duration of not less than 12 hours.

E. Signal Booster Requirements

If used, signal boosters shall meet the following requirements:

1. All signal booster components must be contained within a National Electrical Manufacturer's Association (NEMA) 4-type waterproof cabinet.
2. Battery systems used for the emergency power source shall be contained in a NEMA 3R or higher-rated cabinet.
3. Equipment shall have FCC or other radio licensing authority certification and be suitable for public safety use before installation.
4. Where a donor antenna exists, isolation shall be maintained between the donor antenna and all inside antennas to not less than 20 dB greater than the system gain under all operating conditions.
5. Bi-Directional Amplifiers (BDAs) used in ERRCSs shall have oscillation prevention circuitry.
6. The installation of amplification systems or systems that operate on or provide the means to cause interference on any emergency responder radio coverage networks shall be coordinated and approved.

F. System Monitoring

A listed fire alarm control unit must monitor the ERRCS. If no fire alarm system is provided in the building, the system shall sound an audible signal at a constantly attended on-site location approved by the City of San Diego, such as a 24-hour security desk. A dedicated monitoring panel shall be provided within the Fire Command Center to annunciate the status of all RF emitting devices and system

component locations. Automatic supervisory signals shall include the following:

1. Loss of normal AC power supply.
2. System battery charger(s) failure.
3. Malfunction of the donor antenna(s).
4. Failure of active RF-emitting device(s).
5. Low-battery capacity at 70% reduction of operating capacity.
6. Failure of critical system components.
7. The communications link between the fire alarm system and the ERRCS.

G. Frequency Range

The ERRCS shall be capable of modification or expansion in the event frequency changes are required by the FCC, or additional frequencies are made available by the FCC. The frequency range which must be supported shall be as follows:

1. 800 MHZ uplink band 806 MHZ – 824 MHZ
2. 800 MHZ downlink band 851 MHZ – 869 MHZ
3. 700 MHZ uplink band 799 MHZ – 805 MHZ
4. 700 MHZ downlink band 769 MHZ- – 775 MHZ

H. Radio Communication Antenna Density

Systems shall be engineered to minimize the near-far effect. Radio enhancement system designs shall include sufficient antenna density to address reduced gain conditions.

I. Protection of ERRCS

Riser coaxial cables shall be rated as riser cables and routed through a two-hour rated enclosure. The connection between the riser and feeder coaxial cables shall be made within a fire-resistance-rated enclosure, and passage of the feeder cable in and out of the enclosure shall be fire stopped.

Where an ERRCS is used in lieu of a two-way wired fire department communication system (e.g., high-rise structures, zoned evacuation), then it shall have a pathway survivability of Level 1, Level 2 or Level 3 by meeting at least one of the following:

1. Buildings fully protected by an automatic sprinkler system per NFPA 13 with any interconnecting conductors, cables, or other physical pathways installed in metal raceways.
2. 2-hour fire-rated circuit integrity (CI) or fire-resistive cable.
3. 2-hour fire-rated cable system (electrical circuit protective system).
4. 2-hour fire-rated enclosure or protected area.

Where installed in buildings, conductors and fiber-optic cables shall be installed in accordance with the CEC in any one of the following wiring methods:

1. Electrical metallic tubing
2. Intermediate metal conduit
3. Rigid metal conduit
4. Surface metal raceways
5. Reinforced thermosetting resin conduit (RTRC)

IV. Installation

A. Approval Prior to Installation

No amplification system capable of operating on frequencies used by the Regional 700 and 800 MHz Radio Systems may be installed without prior coordination and approval of the radio system licensee, City of San Diego Department of Information Technology – Wireless Technology Services Division. Any such system shall comply with any standards adopted by this agency.

B. Qualifications of Personnel

The system designer and lead installation personnel must meet the following qualifications:

1. A valid FCC–issued general radio operators license; and
2. Certification of in-building system training issued by a nationally recognized organization, schools such as Associated Public Safety Communications Officials International (APCO), National Association of Business and Education Radio (NABER), Wireless Infrastructure Association (WIA) or the International Association for Radio, Telecommunications and Electromagnetics (iNARTE) or a certificate issued by the manufacturer of the equipment being installed; or an ERRCS certification by the National Institute for Certification in Engineering Technologies (NICET).

C. Acceptance Test

Upon completion of the installation, the system is required to be tested after construction is complete to ensure that the two-way coverage on each floor of the building is not less than 95%. The test procedure shall be as follows:

1. Each floor of the building must be divided into a grid of 20 approximately equal test areas.
2. The test shall be conducted using a calibrated portable radio of the latest brand and model used by the agency of jurisdiction, talking through the agency's radio communications system in both receive and transmit modes.
3. Failure of more than one test area shall result in failure of the test.
4. If two (2) of the test areas fail the test, the floor shall be permitted to be divided into 40 equal test areas. Failure of not more than two (2) nonadjacent test areas shall not result in failure of the test. If the system fails the 40-area test, the system must be altered to meet the 95% coverage requirement.
5. A test location approximately in the center of each test area must be selected for the test, with the radio enabled to verify two-way communications to and from the outside of the building through the radio communications system. Once the test location has been selected, that location shall represent the entire test area. Failure in the selected test location is considered a failure of that test area. Additional test locations are not permitted.
6. The gain values of all amplifiers shall be measured, and the test measurement results shall be kept on file with the building owner so that the measurements can be verified during annual tests.
7. As part of the installation, a spectrum analyzer or other suitable test equipment shall be utilized to ensure the subject signal booster is not generating spurious oscillations. This test shall be conducted at the time of installation.
8. Systems incorporating Class B signal-booster devices or Class B broadband fiber remote devices shall be tested using two portable radios simultaneously conducting subjective voice quality checks. One portable radio shall be positioned not greater than 10 feet from the indoor antenna. The second portable radio shall be positioned at a distance representing the farthest distance from any indoor antenna. With both portable radios simultaneously keyed up on different frequencies within the same band, subjective audio testing shall be conducted and comply with DAQ levels as specified in Section III Part A.
9. The system installed must be registered with the FCC. Proof of registration must be provided to the City.

D. Nonpublic Safety System

Where other nonpublic safety amplification systems installed in buildings reduce the performance or cause interference with the ERRCS, the nonpublic safety amplification system shall be corrected or removed.

E. Final Report

Before issuance of a certificate of occupancy, a final Acceptance Report shall be submitted to the Structural Inspector containing a floor plan and the signal strengths at each location tested, and other relevant information stamped and signed by the FCC-certified technician or Engineer with a statement specifying that the building complies with all of the requirements of CFC Section 510.

V. Maintenance

A. Testing

Testing is required both annually and whenever structural modifications are made that will impact the system. See CFC Section 510.6.1 for requirements for testing.

B. Additional Frequencies

The building owner is responsible for modifying or expanding the ERRCS at their expense if the FCC requires changes or if additional frequencies are made available by the FCC.

Reference Table

- California Building Code
- California Electrical Code
- California Fire Code
- NFPA 13, Standard for the Installation of Sprinkler Systems
- NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems