**SAVANNAH FIRE DEPARTMENT**

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# Requirements for the Design and Installation of Emergency Responder Radio Coverage Systems for New and Remodel Construction in Commercial Buildings

Recent changes to the State of GA Unified Codes Act require the installation of Emergency Responder Radio Coverage System (ERRCS) in new and remodel commercial construction. This publication provides, the requirements for obtaining approvals for design and installation of all ERRCS systems as well as information concerning possible exemption from the requirements listed in this document. All permitted commercial construction and remodel must complete the requirements specified in this document prior to the issue of a Certificate of Occupancy.

## 1. GENERAL

The State of GA Uniform Code Act requires that the Public Safety Radio System be fully operable in the interior of new buildings and remodeled structures. Some modern energy-efficient construction techniques and materials (such as Low-E glass, cementitious coatings, and steel roofs) tend to attenuate the radio signals penetrating the exterior of new buildings. Per the 2018 International Fire Code (IFC) Section 510, all new buildings constructed after January 1, 2019 (except for one- and two-family residences) are required to ensure that the Public Safety Radio System has sufficient radio signal strength to be fully operable throughout the interior of the building.

Building owners subject to the IFC Section 510 are required to submit a Radio Signal Strength Study that demonstrates existing Public Safety Radio System signal levels meet the Code or they will be required to install an Emergency Responder Radio Coverage System (ERRCS) to boost the radio signals up to the required levels. All owners of new or remodeled buildings, as well as their general contractors and ERRCS vendors/installers, should be familiar with all provisions of the relevant codes and standards. This guide augments those documents with further clarification as to how the codes and standards are to be implemented within the City of Savannah.

## 2. PREPLANNING

Because an empirical Radio Signal Strength study cannot be performed until the building is nearly complete, and because of the lead time in procuring and installing an ERRCS, building owners/managers are well advised to consider having a pre-construction signal strength site test study and computer modeling of the proposed structure. This test will be beneficial due to the strong possibility that accommodating an ERRCS installation late in the building process may well delay final building acceptance and add cost beyond what would have been required for a pre-planned ERRCS. Some steps may be taken during building design and early construction that can help alleviate some of the delays and expense should an ERRCS be required. Such steps would include pre-planning roof penetration and conduits for the coax cable feeding the roof-top donor antenna as well as ceiling conduits for the interior Distributed Antenna System (DAS) cabling.

Building owners are encouraged to make sure their building designers are aware early on of the possibility of the need for an ERRCS installation and plan accordingly. All submitted pre-construction expected signal strength studies must be performed by qualified personnel utilizing industry accepted modeling software and certified by a Georgia registered Electrical Engineer.

Documentation regarding the pre-construction signal strength site study must be provided in an electronic form and shall be emailed to the City of Savannah Fire Code Official.

**Fire Marshal Office**
**Tel: 912-644-5960**
**10 W. 33rd St. Savannah, GA 31401**

## 3. RADIO SIGNAL STRENGTH STUDIES

### Existing Buildings and those Seeking Final Approval for Occupancy

Any builder owner needing to demonstrate that the existing radio signal levels inside the building meet the minimum criteria as specified in 2018 International Fire Code Section 510.4.1 will be required to submit a Radio Signal Strength Study. Such studies will be performed by a suitably qualified engineer or technician with an FCC General Radio Operator's License and certification of in-building system training issued by a nationally recognized organization, school or a certificate issued by the manufacturer of the equipment being installed. Acceptance of alternative technical qualifications will be done on a case-by-case basis by the fire code official.

Signal studies can only be conducted once the building is permanently enclosed, i.e., all windows, doors, dry wall, exterior coatings, and roof in place.

Radio Signal Strength Studies shall be conducted in compliance with the 20/40 grid method for each floor as specified in IFC Section 510.5.3.

Delivered Audio Quality (DAQ) testing is a poor determinant of signal level and quality in digital radio systems. In digital radio systems DAQ levels will remain virtually constant from the maximum to the very edge of the minimum signal the receiver is capable of decoding. In addition to the requirements in IFC Section 510.5.3, empirical signal level measurements showing one measurement in the center of each grid and additional signal level measurements taken at four opposing points at the extreme edge of each grid. Where grid edges overlap, extreme edge measurements at a common point on each grid may be shared for each grid.

Empirical measurements will be made with a standard Radio Service Monitor capable of decoding TIA/EIA 102.xxx standard radio communications or equivalent Spectrum Analyzer.

Service Monitor will be connected to an antenna/cable network with a known gain/loss at the frequency under test. All test equipment utilized for empirical measurement must display a current (within the last 12 months) NIST (National Institute of Standards and Technology) traceable calibration certification.

Critical Areas will be required to have 99% floor area radio coverage. In addition to the requirements specified in the previous paragraphs each critical area will be divided into a minimum of 10 equal areas, not to exceed 20 sq. ft. each. Each area will measure approximately 4ft X 5ft or as close as practicably possible. In smaller areas the division of the critical space will be made up of as many 4ft X 5ft areas as possible. For Larger critical areas exceeding 1000 sq. ft. the Authority Having Jurisdiction (AHJ) may allow statistically larger measurement sampling grids. Critical Areas, as defined

in 2019 NFPA 72 Section 24.5.2.2.1, are Fire Command Centers, Fire Pump Rooms, Exit Stairs, Exit Passageways, Elevator Lobbies, Standpipe Cabinets, and Sprinkler Valve Locations.

All measured signal levels regardless of location must not be less than -95dbm. In Common Areas no more than 2 grid squares may display a measured signal level of less than -95dbm. In Critical Areas no measurement may be less than -95dbm.

Documentation submitted shall include a 20/40 grid floor plan for each floor with signal levels annotated on each grid of the floor plan as well as for all critical areas and showing the location of each radiating element. As an alternative a statistically predictive signal level model, based upon empirical measurements, may be substituted.

Since the Public Safety Radio System is a multi-site simulcast system, multipath fluctuations can cause the instantaneously measured signal levels to vary. Personnel conducting signal surveys are encouraged to not use instantaneous signal level readings, but rather sample and average the signal levels for a period of several seconds before recording the signal level for each grid.

For exceptionally large floor areas such as schools and shopping malls, where dividing many square feet into 20 grids creates unreasonably large grids, building owners/managers are strongly encouraged to work with the AHJ Officials to develop a sampling strategy that does not leave large areas untested. The AHJ official will work with the owner/manager of such buildings on a case-by-case basis.

## 4. ERRCS INSTALLATION

For buildings that fail to meet the criteria for sufficient radio signal levels, an ERRCS will be required. An ERRCS captures the radio signal at the rooftop level through an outdoor donor antenna and carries that signal to the interior of the building where it can be amplified by a Bi-Directional Amplifier (BDA), also known as a signal booster. The amplified signal output of the BDA will normally be redistributed within the building via a Distributed Antenna System (DAS).

The amplified signal distributed inside the building should not radiate beyond the perimeter of the building or generate any interference to any licensed radio service.

Per IFC 510.5.1, no ERRCS shall be installed without prior coordination and approval of the fire code official, All ERRCS installation plans shall be submitted to the City of Savannah Fire Code Official's Office for approval. Upon approval, the building owner/manager will be issued a "Letter of Authorization to Retransmit" the radio frequencies licensed to the City of Savannah and Chatham County.

As specified in Section 510.3 of the IFC for new construction a construction permit is required for any installation or modification of an ERRCS. An ERRCS permit shall be obtained from the Fire Marshal's Office once the installation plan has been approved. Fees will apply.

Installation of all ERRCS, to include rooftop antenna components and all required electrical wiring, antenna cables, conduits, bonding, grounding, and lightning protection shall be in compliance with all applicable State of Georgia building and fire codes.

## 5. ALARM SYSTEM INTERFACE

Per IFC Section 510.4.2.4(3) all ERRCS and backup battery systems shall be electrically supervised and monitored by a supervisory service, or when approved by the fire code official, shall sound an audible signal at a constantly attended location. Functions typically monitored from most ERRCS include donor antenna failure, BDA failure, AC power failure, battery failure, and battery charger failure. Where a fire alarm system is installed these fault modes should normally be transmitted to the fire alarm system and displayed on the annunciator panel. The panel display should clearly identify the fault as an ERRCS failure and identify the specific ERRCS fault mode. When faults have been rectified, the alarm panel display should automatically reset.

ERRCS failures should be reported to the building owner/manager or the ERRCS vendor so that restoration of radio service can occur as quickly as possible.

The supervisory monitoring company should not notify the 911 center for a fire response solely because of an ERRCS failure alarm.

The FMO need not be notified of an ERRCS failure unless the outage lasts more than 24 hours. In the event of an outage of more than 24 hours, the Chatham County 911 Center should be notified of the outage and asked to pass the message on to the Fire Marshal's Office during normal business hours and the on-call Fire Marshal during nights, weekends, or holidays. The same procedure should be used to notify the FMO when the ERRCS system has been restored.

**The non-emergency line for the Chatham County 911 Center is.**

**(912)-652-6667.**

All ERRCS shall be equipped with a Knox key override switch that can remotely shut down the system in the event of radio interference issues during an emergency response. Fire Marshal's Office assistance may be required to procure a Knox key override switch.

## 6. FCC REQUIREMENTS

Beyond the provisions of the GA codes, the Federal Communications Commission (FCC) imposes additional rules and regulations on the installation of any ERRCS. All ERRCS designers and installers should be familiar with the provisions of FCC Rules contained in Title 47, CFR, Part §90.219 (Use of Signal Boosters). All ERRCS systems shall use only boosters (also known as BDAs) that are Type Accepted by the FCC.

**All ERRCS amplifiers (Signal Boosters) must be rated as Class "A" Signal Boosters as described in**

**FCC Rules Title 47, CFR, Part §90.219 (a)**

Per §90.219 (b)1(i), the FCC requires that specific documentation be issued to an ERRCS operator that allows the ERRCS system to operate on licensed radio frequencies. As noted above in Section 4, once the ERRCS installation plan has been approved, a Letter of Authorization to Re-transmit will be issued to the building owner/manager to cover this requirement. This Letter of Authorization should be stored or displayed prominently on or near the ERRCS enclosure. The Authorization Letters are valid for one year and must be re-issued at each annual re-inspection (see Section 9 – Maintenance & Annual Inspections).

**No ERRCS shall transmit on any public safety frequency until the Annual Letter of**

**Authorization to Retransmit has been issued by the City of Savannah Radio Shop.**

## 7. MINIMUM PERSONNEL QUALIFICATION REQUIREMENTS

Minimum qualification for the ERRCS system designer and lead installer are specified in IFC Section 510.5.2. and shall include both of the following:

• A valid FCC-issued general radio operator's license

• Certification of in-building system training issued by a nationally recognized organization

school or a certificate issued by the manufacturer of the equipment being installed.

• These qualifications shall not be required where demonstration of adequate skills and

experience satisfactory to the fire code official is provided.

• Any waiver of these requirements will be done on a case-by-case basis by the Fire Marshal.

## 8. LABELING

All ERRCS systems should be labelled at the BDA enclosure. The enclosure should be labelled with the words "ERRCS - Emergency Responder Radio Coverage System." In addition, instructions should be posted for how to completely disable the ERRCS in case of radio interference issues. If used, the Knox over-ride switch should be clearly labelled with the words "ERRCS Remote Over-Ride Switch."

## 9. MAINTENANCE & ANNUAL INSPECTIONS

ERRCS shall always be maintained operational in accordance with IFC Section 510.6 and is the responsibility of the building owner/manager. Results of the annual inspection and test shall be submitted to the Fire Marshal's Office to receive a new Letter of Authorization. A new Letter of Authorization to retransmit on the Public Safety Radio Frequencies should be requested by the inspector at the time of the annual inspection. The new Letter of Authorization will then be sent to the inspector and should be posted at the location of the ERRCS system enclosure.

## 10. ERRCS SERVICE PROVIDERS

Building owner/managers are permitted to use any vendor or contractor to perform Radio Signal Strength studies or to install ERRCS equipment, provided the contractor meets the minimum qualifications as outlined in Section 7 above.

## 11. APPENDIX A – Excerpt and clarification of IFC 2018 FIRE CODE SECTION 510

## EMERGENCY RESPONDER RADIO COVERAGE

**510.1 Emergency responder radio coverage in new buildings:**

All new buildings shall have approved radio coverage for emergency responders within the building based upon the existing coverage levels of the public safety communication systems of the jurisdiction at the exterior of the building. This section shall not require improvement of the existing public safety communication systems.

**510.2 Exceptions:**

Where it is determined by the fire code official that the radio coverage system is not needed. In facilities where emergency responder radio coverage is required and such systems, components or equipment required could have a negative impact on the normal operations of that facility, the fire code official shall have the authority to accept an automatically activated emergency responder radio coverage system.

**510.3 Permit required:**

A construction permit for the installation of or modification of emergency responder radio coverage systems and related equipment is required. Maintenance performed in accordance with this code is not considered a modification and does not require a permit.

**510.4 Technical requirements:**

Systems, components, and equipment required to provide the emergency responder radio coverage system shall comply with IFC Sections 510.4.1 through 510.4.2.5.

**510.4.1 Radio signal strength:**

The building shall be considered to have acceptable emergency responder radio coverage when signal strength measurements in 95% of all areas on each floor of the building meet the signal strength requirements in Sections 510.4.1.1 and 510.4.1.2.

**510.4.1.1 Minimum signal strength into the building:**

A minimum signal strength of -95dBm shall be receivable within the building.

**510.4.1.2 Minimum signal strength out of the building:**

A minimum signal strength of -95dBm shall be received by the agency's radio system when transmitted from within the building.

**510.4.2 System design:**

The emergency responder radio coverage system shall be designed in accordance with IFC Sections 510.4.2.1 through 510.4.2.5.

**510.4.2.1 Amplification systems allowed:**

Buildings and structures that cannot support the required level of radio coverage shall be equipped with a radiating cable system, a distributed antenna system with Federal Communications Commission (FCC) Type Accepted signal boosters, or other system approved by the Fire Marshal and FCC Licensee to achieve the required adequate radio coverage.

**510.4.2.2 Technical criteria:**

The Fire Marshal shall maintain a document providing specific technical information and requirements for the emergency responder radio coverage system. This document shall contain, but not be limited to, the various frequencies required, the location of radio sites, effective radiated power of radio sites, and other supporting technical information.

**510.4.2.3 Standby power:**

Emergency responder radio coverage systems shall be provided with standby power. The standby power supply shall be capable of operating the emergency responder radio coverage system for a duration of not less than 24 hours.

**510.4.2.4 Signal booster requirements:**

If used, signal boosters shall meet the following requirements:

- All signal booster components shall be contained in a National Electrical Manufacturer's Association
- (NEMA) 4-type waterproof cabinet.
- Battery systems used for the emergency power source shall be contained in a NEMA 4-type waterproof cabinet separated from supported electronic equipment.
- The signal booster system and battery system shall be electrically supervised and monitored by a supervisory service, or when approved by the Fire Marshal, shall sound an audible signal at a constantly attended location.
- Equipment shall demonstrate FCC Type Acceptance prior to installation.

**510.4.2.5 Additional frequencies and change of frequencies:**

The emergency responder radio coverage system 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. Additionally, the amplifier must be capable of retransmitting all the now and future digital information contained within the TIA/EIA 102.XX series of standards for mobile radio devices.

**510.5 Installation requirements:**

The installation of the public safety radio coverage system shall be in accordance with Sections 510.5.1 through 510.5.4.

**510.5.1 Approval prior to installation:**

Amplification systems capable of operating on frequencies licensed to any public safety agency by the FCC shall not be installed without prior coordination and approval of Fire Marshal and the Licensee.

**510.5.2 Minimum qualifications of personnel:**

The minimum qualifications of the system designer lead installation personnel and final system design certification shall be as follows:

- A valid FCC-issued General Radiotelephone Operator's License.
- Certification of in-building system training issued by a nationally recognized organization, school or a certificate issued by the manufacturer of the equipment being installed. These qualifications shall not be required where demonstration of adequate skills and experience satisfactory to the fire code official is provided.

**<u>Final system design must be certified and stamped by a Georgia Registered Electrical Engineer.</u>**

**510.5.3 Acceptance test procedure.**

Where an emergency responder radio coverage system is required, and upon completion of installation, the building owner shall have the radio system tested to verify that two-way coverage on each floor of the building is not less than 90 percent. The test procedure shall be conducted as follows:

1. Each floor of the building shall 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 talking through the agency's radio communications system.

Failure of not more than two nonadjacent test areas shall not result in failure of the test.

In the event three of the test areas fail the test, to be more statistically accurate, the floor shall be permitted to be divided into 40 equal test areas. Failure of not more than four nonadjacent test areas shall not result in failure of the test. If the system fails the 40-area test, the system shall be altered to meet the 90-percent coverage requirement.

A test location approximately in the center of each test area shall be selected for the test, with the radio enabled to verify two-way communications to and from the outside of the building through the public agency's radio communications system. Once the 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.

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. In the event the measurement results become lost, the building owner shall be required to rerun the acceptance test to reestablish the gain values.

As part of the installation a spectrum analyzer or other suitable test equipment shall be utilized to ensure spurious oscillations are not being generated by the subject signal booster. This test shall be conducted at the time of installation and subsequent annual inspections.

**510.5.4 FCC compliance.**

The emergency responder radio coverage system installation and components shall also comply with all applicable federal regulations including, but not limited to, FCC Rules 47 CFR Part 90.219.

**510.6 Maintenance.**

The emergency responder radio coverage system shall always be maintained operational in accordance with Sections 510.6.1 through 510.6.3. 14

**510.6.1 Testing and proof of compliance.**

The emergency responder radio coverage system shall be inspected and tested annually or where structural changes occur including additions or remodels that could materially change the original field performance tests. Testing shall consist of the following:

- In-building coverage test as described in Section 510.5.3.
- Signal boosters shall be tested to verify that the gain is the same as it was upon initial installation and acceptance.

- Backup batteries and power supplies shall be tested under load for 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 an additional 1-hour period until the integrity of the battery can be determined.
- Other active components shall be checked to verify operation within the manufacturer's specifications.

**At the conclusion of the testing, a report, which shall verify compliance with Section 510.5.3, shall be submitted to the fire code official.**

**510.6.2 Additional frequencies.**

The building owner shall modify or expand the emergency responder radio coverage system at his or her expense in the event frequency changes are required by the FCC or additional frequencies are made available by the FCC. Prior approval of a public safety radio coverage system on previous frequencies does not exempt this section.

**510.6.3 Field testing.**

Agency personnel shall have the right to enter onto the property at any reasonable time to conduct field testing to verify the required level of radio coverage.

**APPENDIX B: CITY OF SAVANNAH/CHATHAM COUNTY RADIO REPEATER**

**CHANNEL FREQUENCIES AND LICENSED CALL SIGNS**

(Channel 1 is the primary control channel. Channel 2 is the secondary control channel.)

| Channel | Transmit | Receive | License | Site 1 | Site 2 | Site 3 |
|---|---|---|---|---|---|---|
| 1. | 772.53125 | 802.53125 | WQLZ569 | 144.50 | 173.80 | 169.80 |
| 2. | 770.78125 | 800.78125 | WQLZ569 | 144.50 | 173.80 | 169.80 |
| 3 | 774.90625 | 804.90625 | WQLZ569 | 144.50 | 173.80 | 169.80 |
| 4 | 774.40625 | 804.40625 | WQLZ569 | 144.50 | 173.80 | 169.80 |
| 5 | 774.15625 | 804.15625 | WQLZ568 | 144.50 | 173.80 | 169.80 |
| 6 | 773.48125 | 803.48125 | WQLZ568 | 144.50 | 173.80 | 169.80 |
| 7 | 771.73125 | 801.73125 | WQLZ568 | 144.50 | 173.80 | 169.80 |
| 8 | 770.28125 | 800.28125 | WQLZ569 | 144.50 | 173.80 | 169.80 |
| 9 | 769.53125 | 799.53125 | WQLZ568 | 144.50 | 173.80 | 169.80 |
| 10 | 769.25625 | 799.25625 | WQLZ569 | 144.50 | 173.80 | 169.80 |
| 11 | 773.13125 | 803.13125 | WQVI676 | 144.50 | 178.30 | 169.80 |
| 12 | 771.38125 | 801.38125 | WQVI676 | 144.50 | 178.30 | 169.80 |
| 13 | 856.7625 | 811.7625 | WQWM471 | 234.00 | 309.00 | 257.00 |
| 14 | 855.7125 | 810.7125 | WQWM471 | 234.00 | 309.00 | 257.00 |
| 15 | 854.5625 | 809.5625 | WQWM471 | 234.00 | 309.00 | 257.00 |
| 16 | 855.9875 | 810.9875 | WQWM471 | 234.00 | 309.00 | 257.00 |
| 17 | 854.0375 | 809.0375 | WQWM471 | 234.00 | 309.00 | 257.00 |
| 18 | 858.4625 | 813.4625 | WQWM471 | 234.00 | 309.00 | 257.00 |
| 19 | 770.03125 | 800.03125 | WQLZ568 | 144.50 | 173.80 | 169.80 |
| 20 | 770.53125 | 800.53125 | WQLZ568 | 144.50 | 173.80 | 169.80 |
| 21 | 771.13125 | 801.13125 | WQLZ568 | 144.50 | 173.80 | 169.80 |
| 22 | 772.28125 | 802.28125 | WQLZ568 | 144.50 | 173.80 | 169.80 |
| 23 | 772.78125 | 802.78125 | WQLZ568 | 144.50 | 173.80 | 169.80 |
| 24 | 774.65625 | 804.65625 | WQLZ568 | 144.50 | 173.80 | 169.80 |

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