



Emergency Responder Radio Coverage Systems

Technical Criteria for Designers and Installers of
In-Building Radio Coverage Systems

January 1, 2019

HENDERSON COUNTY FIRE MARSHAL'S OFFICE

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1. GENERAL

Henderson County requires that the Henderson County Public Safety Radio Systems be fully operable in the interior of all new building construction. The North Carolina Fire Code Section 510 is the source of this requirement. Building owners are required to either prove that existing radio coverage in the building meets the required signal levels or an Emergency Responder Radio Coverage System (ERRCS) must be installed to bring the radio signals up to the level required by the code. This document serves as the source of "Technical Criteria maintained on the Henderson County Public Safety Radio Systems".

We encourage contractors, vendors, designers, and installers of ERRCS to meet with the Fire Marshal's Office (FMO) as early as possible in their survey and design process in order to ensure that existing radio coverage meets the existing requirement or that any installed ERRCS will meet the code requirements.

2. LOCAL PUBLIC SAFETY RADIO SYSTEMS

Two different Public Safety Radio Systems covering the Hendersonville Area are included in the scope of the requirement. These systems are an analog and digital trunked VHF systems.

The systems are both multi-site multicast networks with generally strong outdoor coverage in Henderson County. Certain construction designs or materials may, however, limit penetration of these radio signals into the interior of some buildings. Installers of ERRCS should generally find a strong signal for a donor antenna at roof top level regardless of the precise pointing azimuth of the donor antenna. In general, it should not be difficult to find a compromise azimuth that will provide adequate donor signal for both systems.

3. EXEMPT PROPERTIES

Existing buildings are exempt from the requirement for interior radio coverage. If the owner of a non-exempt building wishes to provide an ERRCS it will need to follow the guidelines of a new ERRCS.

4. SIGNAL SURVEYS AND AMPLIFIER INSTALLATIONS

Signal surveys conducted for the purpose of demonstrating the existing radio coverage meets the required signal level shall be conducted by personnel meeting the minimum standards of Section 103.2.3 of the Standards and Specifications Manual. Such surveys will be based on the 20-grid, 95% coverage procedure outlined in Section 103.2.4.8 of the Standards and Specifications Manual. Signal level measurements will be required on the active control channel for the county public safety radio system. Minimum signal required is -95 dBm. Received signal levels will be measured with a suitable spectrum analyzer that has been calibrated within the last 12 months.

Documentation required to prove sufficient existing signal coverage will include the signal level measurements taken from the center of all 20 grids on each floor as well as spectrum analyzer screen shots captured for all 20 grids per floor, including sub-grade levels and parking decks. In addition, one set of signal measurements should also be taken outside the building at the main entrance to the building as well as the roof top level. Documentation must be submitted in electronic form such as thumb drives or CD-ROM. FMO personnel may do a spot check to verify the survey results.

In the case where a survey has sampled enough data to conclude that 95% interior coverage at -95 dBm does not exist and that the owner will need to install an ERRCS, the survey can be suspended at the owner's option without submitting the survey documentation to the FMO. If the survey results or the FMO determines that an ERRCS is required, it is recommended that the designer of the system submit the design plan to the FMO prior to implementation.

Design and installation of the ERRCS should be in accordance with all relevant sections of the State Fire Code and Standards. Installation of all ERRCS, to include rooftop antenna components and all required bonding, grounding, and lightning protection will be in

compliance with all building and fire codes and will be subject to permitting and inspection process.

All alarm functions capable of being monitored of the ERRCS will be wired into the main building fire alarm panel. Also, in installations where the ERRCS amplifier is not co-located with the alarm panel, a Knox lock will be installed at the alarm panel that can remotely shut down the ERRCS amplifier if needed. A sign should be prominently affixed near the Knox lock that identifies it as a kill switch for the ERRCS amplifier. FMO assistance will be required to procure a Knox Lock keyed for the respective Henderson County Fire Department.

In addition, it is recommended that designers and installers be familiar with the National Public Safety Telecommunications Council's "Best Practices for In-Building Communications," including Appendices A through E. Particular attention should be paid to automatic management of oscillation modes and in ensuring sufficient attenuation exists between the donor antenna and all indoor antennas (minimum of amplifier gain plus 15 dB)

5. PERMIT PROCESS

As specified in Section 101.2 of the Standards and Specifications Manual, an Emergency Responder Radio Coverage System permit will be required for any installation or modifications of an ERRCS. The permit will be obtained from Henderson County and will have two tracking paths; one for Fire Plan review and inspections and a second path for Electrical Plan review and inspections. The ERRCS permit will be an amendment to the main building permit for the premise. The General Contractor for the project is responsible for submitting all documentation for permit and plan reviews. This includes the ERRCS installation vendor's name and the associated NC Licensed Electrical Contractor's name and license number. Once the plans have been reviewed and approved, the FMO will notify the General Contractor. The General Contractor is responsible for having all plans and permits on the job site. The ERRCS installing contractor and electrical contractor can then request their respective inspections for the final ERRCS approval.

6. FCC AUTHORIZATIONS

The FCC requires a Letter of Authorization for Retransmission that allows the building owner to retransmit on frequencies that are licensed to Henderson County. The FMO will supply the appropriate letters for Henderson County. Those letters must be stored or displayed prominently

on or near the ERRCS amplifier enclosure. The Authorization Letters are valid for one year and must be reissued for each annual re- inspection (see Section 10). In addition, all ERRCS amplifiers operating in Class B mode are required to be registered with the FCC. The FMO will be responsible for registering Class B ERRCS in the FCC data base.

7. MINIMUM QUALIFICATIONS OF PERSONNEL

Minimum qualification for personnel involved in the testing, design, installation, and maintenance of ERRCS is covered in Section 103.2.3 of the Standards and Specifications Manual.

8. VENDORS

Henderson County does not endorse specific vendors or restrict the list of firms that can conduct surveys on install ERRCS. Appendix C is a list of firms that have previously completed surveys and/or installations in the area. It is offered as-is and without warranty to assist developers and property owners in making contact with a service provider if needed.

9. ACCEPTANCE TESTING

Acceptance testing for installed ERRCS shall be conducted by FMO personnel in accordance with Section 103.2.4 of the Standards and Specifications Manual. A set of building plans shall be prepared by the installer with the 20 grids marked off for each floor. If possible, the plans should already be annotated with the installer's own spectrum analyzer measurements for all 20 grids on each floor. The annotated plans will be presented to the FMO personnel conducting the acceptance test at the time of the test or before the test if possible. The FMO will provide personnel and calibrated radios to perform the acceptance testing. The installer will schedule the acceptance testing with the FMO with as much advance notice as possible.

10. ANNUAL RE-INSPECTION

Annual re-inspection and re-testing of all ERRCS is required in accordance with Section 103.3.3 of the Standards and Specifications Manual. Results of the annual re-inspection and test will be reviewed annually by the Fire Marshal's Office during the annual inspection. Letters of Authorization to Retransmit on county frequencies will be re-issued for one additional year at each annual re-inspection.

11. APPENDIX A- EMERGENCY WIRELESS COMMUNICATIONS

(A) *Purpose.* The purpose of this section is to ensure that buildings and structures shall not interfere with the Henderson County' s communication network. Developments shall be modified to accommodate the needs of the county's communications network, to eliminate any interference a development would create or otherwise accommodate the need s of the county's communication network within the development proposal. Adequate provisions shall be made for a radio signal booster system which will correct for a reduction in the radio signal to a level below that required to assure the 95 percent area coverage reliability needed for public safety communications.

(B) *Radio signal booster system required.* Except as otherwise provided no person shall maintain, own, erect, or construct, any building or structure or any part thereof, or cause the same to be done which fails to support adequate radio coverage for public safety entities, including , but not limited to firefighters, emergency medical services and law enforcement officers. The following structures are exempt from these requirements:

- a. One and two family residential buildings;
- b. Buildings constructed prior to the effective date of this section (January 1, 2019) shall be required to comply with public safety radio coverage provisions of this section.
- c. Other facilities as determined exempt by the Fire Marshal's Office in accordance with the current North Carolina Fire Code.

(C) *Easements.* The county may require an easement to utilize the roof for communications infrastructure components to support current and future public safety communication needs. This includes, but not limited to a 12 feet x 25 feet rooftop area for; antennas, base stations, UPS power supplies, and microwave dish antennas. The building owners shall provide a secure climate controlled environment, no less than ten feet x 20 feet x ten feet, suitable for sensitive electronic equipment. This room shall be located within the top floor of roof area to allow for less than 100- foot cable runs to the antenna locations. Power for the equipment in this room shall be fed from the building

emergency generator. Additional construction specifications will be made available as required.

- (D) *Specifications.* All emergency wireless communications shall be constructed in accordance with the standards set forth in the Henderson County Standards and Specifications Manual.
- (E) *Alternative standards.* Based on sound telecommunication engineering practices, the Fire Marshal or his designee may approve alternative standards that are equal to or better than those set forth in this chapter and in the Henderson County Standards and Specifications Manual.

Henderson County N.C. Standards and Specifications Manual

Emergency Wireless Communications

SECTION 101 GENERAL

101.1 Scope. Systems, components and equipment required to assure emergency responder radio coverage, as required by the North Carolina Fire Code shall be in accordance with this section. Buildings shall have approved radio coverage for emergency responders within the buildings based upon the existing coverage levels of the public safety communication systems of the county's jurisdiction at the exterior of the building. This section shall not require improvement of the existing public safety communication system. This section shall not apply to one and two family dwellings.

Exceptions:

1. Where approved by the building official and the fire code official, a wired communication system in accordance with Section 907.2.13.2 of the NC Fire Code shall be permitted to be installed or maintained instead of an approved radio coverage system.
2. Where it is determined by the fire code official that the radio coverage system is not needed.

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

SECTION 102 DEFINITIONS

EMERGENCY RESPONDER: Any agency within the jurisdiction that utilizes radio frequencies for communication. This could include, but not be limited to, various public safety agencies such as fire department, emergency medical services, and law enforcement.

SIGNAL BOOSTER. A device at a fixed location which automatically receives, amplifies, and retransmits on a one-way or two-way basis, the signals received from base, fixed, mobile, and portable stations, with no change in frequency or authorized bandwidth. A signal booster may

be either narrowband (Class A), in which case the booster amplifies only those discrete frequencies intended to be retransmitted, or broadband (Class B), in which case all signals within the passband of the signal booster filter are amplified.

SECTION 103 TECHNICAL REQUIREMENTS

103.1 System design. The emergency responder radio coverage system shall be designed in accordance with Sections 103.1.1 through 103.1.5.

103.1.1 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)-certified signal boosters or other system approved by the fire code official in order to achieve the required adequate radio coverage.

103.1.2 Technical criteria. Henderson County shall maintain a document on the specific technical information of the County's emergency responder radio coverage system. This document may contain, but not be limited to, the various frequencies used, the location of radio tower sites, the effective radiated power (ERP) of those sites, and other supporting technical information.

103.1.3 Secondary power. The emergency responder radio coverage system shall be equipped with a secondary source of power. The secondary source of power shall be either a battery system or an emergency generator. The secondary power supply shall supply power automatically when the primary power source is lost. The secondary source of power shall be capable of operating the emergency responder radio coverage system for a period of at least 6 hours. The battery system shall automatically charge in the presence of external power input.

103.1.4 Signal booster requirements. If used, signal boosters shall meet the following requirements:

1. All signal booster components shall be contained in a NEMA 4- or NEMA 4X- type enclosure.
2. The battery system shall be contained in a NEMA 4- type waterproof cabinet with appropriate venting.
3. The system shall include automatic alarming of malfunctions of the signal booster and battery system. Any resulting trouble alarm shall be automatically transmitted to an approved central station or proprietary supervising station as defined in NFPA 72 or, when approved by the fire code official, shall sound an audible signal at a constantly attended location.

4. Equipment shall have FCC certification prior to installation.

103.1.5 Additional frequencies and change of frequency. 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 frequency are made available by the FCC.

103.2 Installation requirements. The installation of the public safety radio coverage system shall be in accordance with Sections 103.2.1 through 103.2.5.

103.2.1 Approval prior to installation. No amplification system capable of operating on frequencies licensed to any public safety agency by the FCC shall be installed without prior coordination and approval of the fire code official.

103.2.2 Permit required. A construction permit, as required by Section 105.7.5 of the, Fire Code, shall be obtained prior to the installation of the emergency responder radio coverage system.

103.2.3 Minimum qualifications of personnel. The minimum qualifications of the system designer and lead installation personnel shall include:

1. A valid FCC-issued General Radio Operators License, and
2. Certification of in-building system training issue a nationally recognized organization or school or a certificate issued by the manufacturer of the equipment being installed.

The agency may waive these requirements upon successful demonstration of adequate skills and experience satisfactory to the fire code official.

103.2.4 Acceptance test procedure. When an emergency responder radio coverage system is required, and upon completion of installation, the building owner shall have the radio system tested. The test procedure shall be conducted as follows:

1. Each floor of the building shall be divided into a grid of 20 approximately equal 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.
3. A maximum of two nonadjacent areas shall be allowed to fail the test.
4. In the event that three of the areas fail the test, in order to be more statistically accurate, the floor may be divided into 40 equal areas. A maximum of four nonadjacent areas shall be allowed to fail the test. If the system fails the 40-area test, the system shall be altered to meet the 95- percent coverage requirement.
5. A test location approximately in the center of each grid area shall be selected for the test, then the 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. Once the test location has been selected, that location shall represent the entire area. If the test fails in the selected test location, that grid area shall fail, and prospecting for a better spot within the grid area shall not be allowed.
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. In the event that the measurement results become lost, the building owner shall be required to rerun the acceptance test to reestablish the gain values.
7. As part of the installation a spectrum analyzer or other suitable test equipment shall be utilized to insure spurious oscillations are not being generated by the subject signal booster. This test shall be conducted at time of installation and subsequent annual inspections.
8. The building shall be considered to have acceptable emergency responder radio coverage when signal strength measurements in 95 percent of all areas on each floor of the building meet the signal strength requirements of:
 - a. A minimum signal strength of -95 dBm shall be receivable within the building.
 - b. A minimum signal strength of -100 dBm shall be received by the agency's radio system when transmitted from within the building.

103.2.5 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 47 CFR 90.219.

103.3 Maintenance. The emergency responder radio coverage system shall be maintained in accordance with Sections 103.3.1 through 103.3.5.

103.3.1 Maintenance. The public radio coverage system shall be maintained operational at all times.

103.3.2 Permit required. A construction permit, as required by Section 105.7.5 of the N.C. Fire Code, shall be obtained prior to the modification or alteration of the emergency responder radio coverage system.

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

1. In-building coverage test as described in Section 103.2.4.
2. Signal boosters shall be tested to ensure that the gain is the same as it was upon initial installation and acceptance.
3. Backup batteries and power supplies shall be tested under load for a period of one hour to verify that they will properly operate during an actual power outage. If within the one-hour test period the battery exhibits symptoms of failure, the test shall be extended for additional one-hour periods until the integrity of the battery can be determined.
4. All other active components shall be checked to verify operation within the manufacturer's specifications.
5. At the conclusion of the testing a report which shall verify compliance with Section **103.3.4** shall be submitted to the fire code official.

103.3.4 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.

103.3.5 Field testing. The Henderson County Fire Marshal's Office 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.

SECTION 104 REFERENCED STANDARDS

200 FCC 47 CFR 90.219 - 2007
NFPA 72 – 2007

Private Land Mobile Radio Services - Use of Signal
Boosters National Fire Alarm Code

13. APPENDIX C - SERVICE PROVIDERS

Emergency Responder Radio Coverage Service Providers as of 12/20/18

Neither Henderson County nor any emergency services organizations within Henderson County do not endorse specific vendors or restrict the list of firms that can conduct surveys or install ERRCS systems. This is a list of firms that have previously completed surveys and/ or installations in the North Carolina. It is offered as-is and without warranty to assist developers and property owners in making contact with a service provider. In alphabetic order:

Blue Stream Professional Services

Ricky Stedman Construction Manager/DAS & Small Cell

(404) 293-6559

rstedman@bluestreampro.com

ComSpec Corporation

www.comspeccorp.com

336-370-1456 (main office)

Rick Holowell (cell 336-202-6006)

Fuze Wireless

www.fuzewireless.com

Lord and Company

Bill Cabrera

(703) 361-3530

b.cabrera@lordcotech.com

Kimball Communications

Brian Kimball

(828) 697-6232

brian@kc2w.com

Pierson Wireless

Ross Pierson - (402) 326-5800

www.piersonwireless.com

ross@piersonwireless.com

Wireless - Communications Service

Mark Durner

mdurner@cslwnc.com

14. APPENDIX D – HENDERSON COUNTY RADIO SYSTEM

TECHNICAL INFORMATION

The Henderson County VHF trunked radio system transmits from six tower sites around the county. The system utilizes different frequencies at each tower. Each channel has a bandwidth of 6.25 kHz.

Bearwallow Mountain	35.461382 N	-82.357620 W
Corbin Mountain	35.168065 N	-82.434557 W
Forge Mountain	35.363353 N	-82.624108 W
Courthouse	35.314551 N	-82.460322 W
Pinnacle Mountain	35.229938 N	-82.539751 W
Sugarloaf Mountain	35.384983 N	-82.299901 W

The system utilizes the following frequencies for each site. The installer should coordinate with Henderson County to determine which site would be best suited for the ERRCS

SITE	DOWNLINK TO SUBSCRIBERS	UPLINK TO REPEATERS
COURTHOUSE	150.93500	157.48500
COURTHOUSE	151.97000	158.16000
COURTHOUSE	153.37250	158.18250
COURTHOUSE	153.58250	158.19750
COURTHOUSE	153.61250	159.78750
BEARWALLOW	150.85250	158.19000
BEARWALLOW	150.94250	159.93000
BEARWALLOW	150.97250	159.96000
BEARWALLOW	153.23750	159.86250
BEARWALLOW	153.43250	160.16250
EDNEYVILLE	151.97750	157.47750
EDNEYVILLE	153.46250	159.75750
EDNEYVILLE	153.49250	159.80250
EDNEYVILLE	153.68750	160.02750
EDNEYVILLE	154.61000	160.19250

SITE	DOWNLINK TO SUBSCRIBERS	UPLINK TO REPEATERS
CORBIN	150.95000	158.22750
CORBIN	153.73250	159.62250
CORBIN	152.86250	159.66750
CORBIN	153.10250	159.84750
CORBIN	151.60250	159.96750
CORBIN	150.86750	159.60000
CORBIN	151.52750	159.63000
CORBIN	153.02750	159.71250
PINNACLE	150.95750	158.15250
PINNACLE	153.20750	158.27250
PINNACLE	153.22250	158.33250
PINNACLE	153.28250	159.77250
PINNACLE	153.59750	160.08000
PINNACLE	153.16250	159.72000
PINNACLE	153.32750	159.74250
PINNACLE	153.50750	159.98250
FORGE	150.88250	159.68250
FORGE	152.26250	159.81750
FORGE	153.44750	160.13250
FORGE	153.52250	160.01250
FORGE	154.55500	159.92250