



LAS VEGAS FIRE & RESCUE

Uniform Guidelines for Public Safety / First Responder Radio Amplification Systems

TITLE: Uniform Guidelines for Public Safety and First Responder Radio Amplification Systems

SCOPE: To provide performance requirements for Public Safety and Fire Responder radio amplification systems in structures.

PURPOSE: To provide guidance in the performance requirements for a radio amplification system in a building, structure, or commercial facility, to prevent loss of communications in an emergency event. It is not the intent of this document to limit or prohibit the use of equipment or new technologies, such as a fiber distributed antenna system.

I. CODE REQUIREMENT

In accordance with the provisions of the 2003 NFPA 1 - Uniform Fire Code, as adopted by the City of Las Vegas, and 13.7.2.27.2.2, high rise buildings shall be provided with an approved two-way Fire Communication System.

Where required by the law enforcement or fire departments (see Section III), the exception listed in section 13.7.2.27.2.2 shall be utilized, which requires that an approved Fire Department radio system shall be installed. [NFPA-1 § 13.1.11]

II. DEFINITIONS

Authorized Company: A company that employs individual(s) that are qualified by the equipment manufacture (in writing) to work on the repeater system.

DAQ: Delivered Audio Quality Definitions: This is a universal standard often cited in system designs and specifications.

- DAQ 1: Unusable, speech present but unreadable.
- DAQ 2: Understandable with considerable effort. Frequent repetition due to noise / distortion.
- DAQ 3: Speech understandable with slight effort. Occasional repetition required due to noise / distortion.
- DAQ 3.5: Speech understandable with repetition only rarely required. Some noise / distortion.
- DAQ 4: Speech easily understood. Occasional noise / distortion.
- DAQ 4.5: Speech easily understood. Infrequent noise / distortion.
- DAQ 5: Speech easily understood.

FCC: Federal Communications Commission.

LVFC: Las Vegas Fire Communications

LVMPD: Las Vegas Metropolitan Police Department (a.k.a. Metro)

OET 65 Standards: FCC's Bulletin 65 provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.

Public Safety / First Responder: Public Safety or First Responder agencies which are charged with the responsibility of responding to emergency situations. These include, but are not limited to: law enforcement departments, fire departments, and emergency medical companies.

Radio Repeater: Component of a radio amplification system that receives a signal and retransmits that signal, helping the signal to travel over a greater range.

SNACC: Southern Nevada Area Communications Council. Overseas, manages, and maintains the fire and EMS radio system utilized by multiple departments in southern Nevada.

III. RADIO COVERAGE.

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 emergency responders, including but not limited to firefighters, emergency medical personnel, and law enforcement officers.

IV. WHERE REQUIRED

- A. Radio amplification systems shall be installed where specifically required by the Fire Code, and where the following criteria exist:
 - 1. Inbound Signals: Where inbound field strength is less than -95 dBm throughout 95% of the area of each floor of the building from the nearest LVMPD and SNACC site for the radio associated to that radio system, a radio amplification system shall be installed within the building.
 - 2. Outbound Signals: Where the outbound signal strength received from a portable radio throughout each floor throughout the building to the receiver at the nearest LVMPD and SNACC site is less than -95 dBm from a radio associated with that radio system with a maximum of 3 watts of strength, a radio amplification system shall be installed within the building.

V. SYSTEM DESIGN

- A. The system design, and installation, shall in no case exceed the FCC's OET 65 Standards.
- B. **Minimum Signal Strength and Coverage:** For purposes of this section, adequate radio coverage shall be designed in accordance with the following:
 - 1. Systems shall be designed to provide a minimum signal level of -95 dBm for two-way coverage (both talk-out and talk-in) on each floor, and shall be available in 95% of each floor's area. Coverage shall also be provided for any mechanical penthouses, elevator machine rooms, etc., located at the top of the structure.
 - 2. Critical rooms, including but not limited to such areas as, Fire Command Center, Fire Pump Room, Emergency Generator Room, Stairwells with a standpipe, and other staging areas as identified by the Fire Department, shall have a minimum signal level -95 dBm for 98% of the room.
- C. **Reliability Factor:** The system shall be designed and capable of providing a 95% reliability factor.
- D. **Supported Frequencies:** The radio system shall support frequencies in the 700 and 800 Megahertz public safety bands as utilized by Public Safety and First Responder agencies as may be used by SNACC.
- E. **Reject filters:** Notch filter sections shall be incorporated to minimize adjacent channel cellular and SMR (Nextel) degradation of the signal booster performance. The minimum downlink band adjacent band rejection shall be 35 dB or greater at 865 MHz and 870 MHz
- F. **Band Migration Capability:** The signal booster shall include re-tunable or replaceable filters to accommodate rapid and economic passband changes in the event of mandatory FCC changes within the 806-824 and 851-869 MHz band. The use of non-adjustable and non-replaceable RF input and output filters is prohibited.
- G. **Output Level control:** An automatic output leveling circuit shall be included for both passbands with a minimum dynamic range of **60 dB**, less any gain reduction setting, to maintain FCC out of band and spurious emission compliance.
- H. **Degraded performance in emergencies:** The system shall be designed to allow degraded performance in adverse conditions, such as abnormally high temperatures resulting from nearby fires, extreme voltage fluctuations or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) will not be implemented as the standard mode for public safety applications. It is the purpose of this specification to assure the maximum possible level of communications to public safety

personnel depending upon the signal booster even to the extent of damaging the signal booster as long as some communications benefit can be provided during the emergency.

- I. **Mode of Operation:** The system shall be normally powered on and shall continuously provide passing of frequencies within the Public Safety and First Responder bands.

VI. SYSTEM COMPONENTS

- A. **Compatibility:** The equipment, including but not limited to repeaters, transmitters, receivers, signal boosters, cabling, fiber distributed antenna system, etc., shall be compatible with the existing communication systems utilized by the Public Safety and First Responder agencies.
- B. **Power Supplies:** Any part of the installed system(s) which contain electrically powered components, the system(s) shall be capable of operating on the emergency generator system (if provided) and an independent battery system. The power sources shall meet the requirements of Level 1, Type 10, Class X system of NFPA 110. The battery system shall be provided such that the system is capable of continuous duty for four (4) hours in the event of primary and generator power failure. Systems provided where an emergency onsite generator is not present, shall provide battery capacity of twelve (12) hours of continuous duty.
- C. **Survivability:**
 1. Physical Protection: All wiring and fiber optics shall be installed in conduit.
 2. Fire Performance: All main risers or trunks of the of the antenna system shall be installed with resistance to attack from a fire using one of the following methods:
 - a. A 2-hour fire rated cable or cable system.
 - b. Routing the cable through a 2-hour fire rated enclosure(s) or shaft(s).
 - c. A system configured in a looped design, routed through 1-hour fire rated enclosure(s) or shaft(s). The circuit shall be capable of transmitting and receiving a signal during a single open or nonsimultaneous single ground fault on a circuit conductor.
 - d. Performance alternative approved by the authority having jurisdiction.Laterals to individual antennas do not have to be protected by a fire rated enclosure.
- D. **Cabinet:** The signal booster and all associated RF filters shall be housed in a single, NEMA 4 certified, painted steel weather tight box. The cabinet shall be large enough to dissipate internal heat without venting the inside of the cabinet to the outside atmosphere. External or exposed RF filters are unacceptable.
- E. **Operating temperatures:** -22°F to $+120^{\circ}\text{F}$ (-30°C to $+50^{\circ}\text{C}$) minimum temperature range, including microprocessors. Equipment installed on the roof of structures shall be rated for the expected extreme temperatures associated with rooftop installations.
- F. **FCC Requirements:** Active Equipment (Signal Boosters and Bidirectional Amplifiers) Shall meet FCC Requirements.
- G. **Passive Equipment:** Passband Shall be 700-900 Mhz, IP rating of 2 Ghz.
- H. **Cable:** Passband shall be 700-900 MHZ. Cable shall be rated for fire plenum and riser rating.

VII. LICENSING

- A. All Fire Department radio frequencies will be FCC licensed under the SNACC system. All fees associated with the licensing shall be paid by the property owner.
- B. All testing must be done on frequencies authorized by the FCC. A valid FCC license will be required if testing is done on frequencies different from the police, fire or emergency medical frequencies.

VIII. APPROVAL AND TESTING PROCEDURES

- A. **Design Approval:** Plans shall be submitted and approved prior to installation. The following information shall be provided to the LVFC unit representative by the designer/contractor:

1. A minimum of three (3) copies of detailed drawings showing the location of the amplification equipment and associated antenna systems which includes a view showing building access to the equipment; and
 2. A minimum of three (3) copies of schematic drawings of the electrical system, backup power, antenna system and any other associated equipment relative to the amplification equipment including panel locations and labeling.
 3. A minimum of one (1) copy of the Manufacturer's data sheets on all equipment to be installed.
- B. The LVFC will review plans and specifications. Upon acceptance, plans will be stamped to indicate approval. Stamped plans are required to be present at the acceptance test. Any field changes that occur during construction shall be incorporated into new As-Built plans, including any manufacturer's data sheets for any equipment changes not submitted in the original submittal. As-Built plans, if required due to system changes, shall be submitted to the Clark County Fire Department for approval.
- C. Commissioning Test: It is the building owner's responsibility to ensure that a commissioning test of the radio repeater system occurs prior to C of O for the building. The test shall ensure that two-way coverage on each floor of the building meets the minimum coverage requirements described above.
- D. Tests shall be made using frequencies close to the frequencies used by the Fire Department and appropriate emergency services. If testing is done on the actual frequencies, then this testing must be coordinated with the LVFC unit. All testing must be done on frequencies authorized by the FCC. A valid FCC license will be required if testing is done on frequencies different from the police, fire or emergency medical frequencies.
- E. Testing Procedures:
1. Minimum Signal Strength: For testing system signal strength and quality, the testing shall be based on the DAQ system. A DAQ level below 3.0 shall be considered a failed test for a given grid cell.
 2. DAQ shall be subdivided into a grid system consisting of 40 equally spaced grids for testing. The number of grids shall be adjusted such that the grid spacing is not less than twenty-five (25) feet, nor shall it exceed more than fifty (50) feet. Signal strength measurements shall be taken at the center of each grid.
 3. A maximum of two (2) nonadjacent grid cells will be allowed to fail the test. In the event that three of the areas fail the test, in order to be more statistically accurate, the testing grid resolution maybe doubled. A maximum of four (4) nonadjacent grid cells will be allowed to fail the test. If the number of grid cells is adjusted to meet the spacing requirements of Item 2 above, the number of failed cells permitted shall be adjusted accordingly to meet the 95% coverage requirement.
 4. Failures shall not be allowed in critical areas, including but not limited to the Fire Command Center, Fire Pump Room, Emergency Generator Room, Stairwells with a standpipe, Elevator Lobbies serving the Emergency Elevator, and other areas as identified by the Fire Department.
 5. 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.
 6. Measurements shall be made with the antenna held in a vertical position at three (3) to four (4) feet above the floor. (portable radio worn on the belt or turnout coat pocket).
- F. Pre Testing: It is the building owner's responsibility to have the radio system pre-tested to ensure that two-way coverage on each floor of the building meets the minimum coverage described above.
- G. Acceptance Testing:
1. All acceptance testing shall be done in the presence of a LVFC representative, or by the LVFC unit at no expense to the City.
 2. Small scale drawings (11" x 17" maximum) of the structure shall be provided by the owner/contractor. The plans shall show each floor divided into the grids as described above, and the results of the pretesting. The plans shall show each floor divided into the grids as described above. Each grid shall be labeled to indicate the DAQ result from the commissioning test.
 3. The owner/contractor shall provide the latest approved plans for the system, including any manufacture's data sheets for any equipment changes not submitted in the original submittal.

4. All testing results of the repeater (output wattage, gain level, etc).
5. The owner shall provide written documentation certifying that an acceptable sweep test to measure the level of RF radiation has been conducted and that the antennae system complies with FCC OET 65 Standards.

IX. MAINTENANCE AND ANNUAL TESTING.

- A. Annual tests will be conducted by the LVFC unit or authorized company.
 1. If communications appear to have degraded or if the tests fail to demonstrate adequate system performance, the owner of the building or structure is required to remedy the problem and restore the system in a manner consistent with the original approval criteria.
 2. The re-testing will be done at no expense to the City or the appropriate emergency services departments as required in the original testing procedures.
- B. Maintenance & Servicing: At final acceptance the building owner shall supply a letter to the Fire Department accepting the property owner's responsibilities. These responsibilities are as follows:
 1. Upgrades to system as directed by the Las Vegas Fire & Rescue;
 2. Maintenance contract in place with name of authorized company, who will provide a 24 hour by 7 day emergency response within two (2) hours after notification. The system shall be maintained in accordance with FCC requirements.
 3. This letter is to be on company letterhead signed by the property owner or a legal representative.
 4. Maintain a list of contact personnel with phone numbers at the radio repeater system cabinet. The contact personnel shall have knowledge of the building and the repeater system and be available to respond to the building in the case of an emergency.

X. FIRE DEPARTMENT RADIOS

The owner shall provide the Fire Department with portable radios as follows:

- A. A minimum of two (2) radios, and no less than one (1) radio for every 1 million square feet, or portion thereof, of building area, shall be provided to the Las Vegas Fire Department.
- B. Radios shall be Motorola Model XTS/XTL 5000, with lapel microphone.
- C. Warranty and ownership of the radios shall be transferred to the Las Vegas Fire Department upon successful completion of the acceptance test.