CRFD	Castle Rock Fire and Rescue Department **LIFE SAFETY DIVISION GUIDELINE** Subject: BDA Radio Amplification Checklist Date initiated: 02-1-2016 Date revised: Approved: Richard Auston, Division Chief of Life Safety Division

APPLICABLE CODES AND STANDARDS:

- International Fire Code (IFC), Edition 2012

INTENT:

The intent of this document is to establish accurate guidelines for the application for a permit and installation for Emergency Responder Radio Coverage as required by the **IFC Section 510.**

SCOPE:

The scope of this document is to provide the necessary steps in the application, installation and acceptance testing for these systems

DEFINITIONS:

CRFD :	Castle Rock Fire & Rescue Department
BDA:	Bi-directional radio antenna
FCC :	Federal Communications Commission
DAS :	Distributed Antenna System
DRCC :	Douglas Regional Communication's Center
DAQ :	Delivered Audio Quality

ATTACHMENTS:

1) None

RESPONSIBILITY:

It is the responsibility of the Life Safety to complete a permit application and conduct a review of these systems with an understanding of the fire code requirements by following this guideline.

PROCESS REQUIRED:

Radio Amplification System

CRFD encourages you to use this checklist for your radio amplification system plan submittal.

Items on this checklist will aid you in providing us with a complete submittal. Incomplete submittals will not be accepted and returned until all necessary information is provided. ***No work will be allowed*** until CRFD has issued a permit for your project. If you have any questions please feel free to contact us at FPO@CRGOV.COM

- 2 complete sets of plans must be submitted
- Name, address and phone numbers of installing contractor and designer
- FCC Radiotelephone Operator License Number (PG) for designer and tester
- Name of owner and occupant
- Location of project, including street address
- Location of critical areas, including: Fire Command Centers, Elevators & Elevator Lobbies, Stairways, Protect-in-
- places Areas, Areas of Refuge, Fire Equipment Rooms, High-hazard Areas, Basements, Underground Parking Areas
- and other areas deemed critical by CRFD
- Indication of what type of system is being installed i.e. radiating cable system and/or a distributed antenna system (DAS) with FCC-certified signal boosters, or system otherwise approved by CRFD in order to achieve the required adequate radio coverage
- Spec sheets (cut sheets) on components and equipment to be installed
- Sheet Number on all sheets

Performance Requirements

Radio amplification system design must be coordinated between the property owner, vendor, CRFD, and the Douglas Regional 911 Communication's Center (DRCC). The frequency range which must be supported shall be current public safety frequencies of 764-776, 773-797, 803-806, 806-824, 851-870 MHz. System shall be capable of upgrade to allow for instances where the jurisdiction changes or adds system frequencies in order to maintain radio system coverage as originally designed. It shall be the responsibility of CRFD and DRCC to ensure adequate radio signal strength to and from the building. That signal must be brought into the building and sent back out in accordance with the following:

- A minimum average in-building field strength of 5µV (-95 dBm) throughout 90% of the area of each floor of the building when transmitted from DRCC.
- As used in this Checklist, 90% coverage or reliability means CRFD portable radios will transmit 100% of the time at the field strength and levels defined in this Checklist within 90% of the specified area.
- The following critical areas must be 99% covered:
    - Fire Command Centers, Elevators & Elevator Lobbies, Stairways, Protect-in-place Areas,

Areas of Refuge, Fire Equipment Rooms, High-hazard Areas, Basements, Underground Parking Areas and other areas deemed critical by CRFD.

- If the outside field strength at the building's receive antenna is less than –95 dBm, then the minimum required in- building field strength shall equal the field strength being delivered to the receive antenna.
- A minimum average signal strength of 5μV (-95 dBm) shall be received at the donor site or other signal strength as required by CRFD.
- 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.

Information Required on Bandwidth Calculations form

Radio frequency field strength information including:

Name of person/agency conducting test or other source of field strength information

List of frequencies and bandwidth calculations to be included in system

Location, elevation, date, and time of field strength test

System design Requirements

- Make, type, model, and size of all cable, amplifiers, antennas, batteries, etc. (spec sheets)
- Location of all cable, amplifiers, battery panels, etc.
- Type and locations of hangers, sleeves, braces, and methods of securing cable and antennas, when applicable
- Battery and battery charging calculations
- System design calculations
- Where the equipment is to be installed as an addition to an existing system, enough of the existing system indicated on the plans to make all conditions clear
- The working plan submittal shall include the manufacturer's installation instructions for any specially listed equipment, including descriptions, applications, and limitations for any cable, amplifiers, antennas, batteries, etc.
- Radio amplification system equipment shall be located in an approved area with adequate environmental controls required by the product manufacturer. The equipment shall be housed in a NEMA-4 sealed cabinet which must protect it from smoke, water, and fire damage.

If any part of the installed system or systems contains an electrically powered component, the system shall be capable of operation on an independent battery and/or generator system for a period of at least twelve (12) hours without external power input or maintenance. The battery system shall automatically charge in the presence of external power input. All equipment shall be properly grounded. The system shall be

supervised by the building's fire alarm system, where provided, for power supply and operational status. If amplification is used in the system, all FCC authorizations for public safety radio amplification must be obtained prior to the use of the system. A copy of these authorizations shall be provided to CRFD.

System Testing and Acceptance

The public safety radio amplification system shall be tested upon completion and prior to final acceptance of the system. All tests shall be conducted, documented, and signed by a person in possession of a current FCC Radiotelephone Operator License. All test records shall be retained on the inspected premises and a copy submitted to CRFD.

- Tests shall be made using frequencies used by the emergency services and authorized by the FCC
- Acceptance tests will be witnessed by a Fire Prevention Officer and will be coordinated through the Fire Marshal's office
- Product information and specifications (cut sheets) for all equipment used in calculations

Measurements shall be made using the following guidelines:

With a service monitor using a receive antenna of equal gain to CRFD's standard portable radio antenna Measurements shall be made with the antenna held in a vertical position at 3 to 4 feet above the floor A calibrated service monitor or spectrum analyzer (with a factory calibration dated within 24 months) may be used to make the tests. If measurements in a location are varying, then average measurements may be used. A Fire Prevention Officer will do a hands-on radio test to check the areas for proper radio operation/reception

Acceptance tests will be witnessed by a Fire Prevention Officer using the following procedures:

- Signal strength, both inbound and outbound as defined in this checklist, shall be measured on each and every floor including stairwells, basements, penthouse facilities, and parking areas of the structure.
- The structure shall be divided into 100-foot grids and the measurements shall be taken at the center of each grid. In the critical areas specified in this checklist requiring 99% coverage, the grids shall be reduced to 25-feet. The size of the grids may also be reduced upon recommendations of the Fire Prevention Officer, in areas where displays, equipment, stock or any other obstruction may significantly affect communications in those areas.
- The test shall be conducted using a calibrated spectrum analyzer or a calibrated automatic signal level measurement recording system.

- A spot located approximately in the center of a grid area will be selected for the test.
- Once the spot has been selected, prospecting for a better spot within the grid area will not be permitted. Each grid area will be tested for transmission/reception at the minimum signal strength of 5µV (-95 dBm). If signal strength fails to meet the requirement, the grid area shall be marked as a fail.
- The gain values of all amplifiers shall be measured and the test measurement results shall be kept on file at the facility and the fire department 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.

CRFD personnel will perform a Delivered Audio Quality (DAQ) scale test from the same spots used for signal strength testing. DAQ is a universal standard using the following measures:

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

The minimum allowable DAQ for each grid cell is 3. Not more than two (2) nonadjacent grid cells can be allowed to fail the test.

Failures shall not be allowed in critical areas requiring 99% coverage.

DAQ testing will be performed with CRFD field radios on an operations or other repeated channel as assigned by

DRCC.

System Maintenance

Public safety radio amplification systems shall be maintained in an operative condition at all times and shall be replaced and or repaired where defective. An annual test shall be conducted by a qualified technician of all active components of the system including, but not limited to:

- Amplifiers: Shall be tested to ensure that the gain is the same as it was upon initial installation and acceptance. 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.
- Backup batteries: 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, in the opinion of the testing technician, the battery exhibits symptoms of failure, the test shall be

extended for additional one-hour periods until the testing technician confirms the integrity of the battery.

- All other active components shall be checked to determine that they are operating within the manufacturer's specifications for the intended purpose.

Annual tests shall also be conducted by CRFD using field radios during the occupancies annual fire inspection. If the 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.

When building additions or alterations occur to buildings with approved systems, the owner of the building or structure is required to maintain the system in a manner consistent with the original approval criteria in order to obtain a final inspection for occupancy.