

Department of Emergency
Communications, Preparedness and
Response
City of Richmond, Virginia

Compliant Public Safety In-Building Two-
Way Radio Communications Enhancement
System Requirements
Rev. 1.0

January 11, 2024

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Definitions

The following words, terms and phrases, when used in this document, shall have the meanings ascribed to them in this section, except where the context clearly indicates a different meaning:

- (1) CoR means City of Richmond.
- (2) BDA means Bi-Directional Amplifier which refers to specialized electronics typically used in conjunction with an associated donor antenna, distributed antennas, filters, and cabling in order to boost/enhance inbound and outbound radio coverage performance typically within a building or facility.
- (3) DAS means Distributed Antenna System which refers to the antenna network and associated infrastructure cabling/connectors, used in conjunction with specialized electronics, designed to distribute desired wireless transmissions often throughout large buildings or facilities.
- (4) NFPA 1221 2019 means the National Fire Protection Association Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems (2019 edition).
- (5) DAQ means Delivered Audio Quality which is a common signal quality measure for analog/digital two-way radio communications systems.
- (6) dBm means decibel relative to a milliwatt which is power measurement often used to define signal strength.
- (7) FCC means Federal Communications Commission which is the Federal agency tasked to regulate interstate and international communications through cable, radio, television, satellite and wire.
- (8) City of Richmond 800 MHz System means the primary Citywide Public Safety two-way radio emergency communications system as defined in the City's Compliant Public Safety In-Building Two-Way Radio Communications Enhancement System Requirements document.
- (9) IBC 2018 means International Building Code (2018 edition).
- (10) FCC Signal Booster Database means the FCC Part 90 online database designed to catalog and track active BDA/DAS implementations (<https://signalboosters.fcc.gov/signal-boosters/>).



Introduction

The City of Richmond, Virginia has adopted NFPA 1, Fire Code, 2018 Edition (NFPA1-2018) as its Fire Code, NFPA 101, Life Safety Code, 2018 Edition (NFPA101-2018) as its Life Safety Code, and NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems, 2019 Edition (NFPA1221-2019) as its standard for Communications Enhancement Systems. NFPA1-2018 and NFPA101-2018 provide requirements for reliable public safety radio system coverage in occupancies, and NFPA1221-2019 provides requirements for the design, installation and maintenance of communications enhancements systems.

Modern building design and construction techniques, especially those required to satisfy requirements for LEED-certified building designs, make it difficult or impossible for the City to provide reliable two-way radio coverage for first responders operating inside of buildings. Two-way radio communications enhancement systems help ensure the safety of building occupants and first responders by extending the coverage of a public safety communications system to the interior areas of the building through the use of special bi-directional amplifiers (BDAs) and a network of indoor antennas strategically located to provide reliable public safety radio system coverage throughout the interior of a building. The BDA and network of antennas is sometimes collectively known as a Distributed Antenna System (DAS).

DAS systems must be designed, installed, maintained and repaired by qualified personnel to ensure that they meet the City's coverage reliability code requirements and do not cause unintended harmful interference to City radio system or other users of the RF spectrum licensed by the Federal Communications Commission (FCC).

The FCC requires that DAS systems be either operated by the licensee of the public safety radio system, or explicitly authorized by the licensee. Additionally, the licensee must enter the DAS into a nationwide registry maintained by the FCC, so the appropriate parties can be contacted should the DAS cause interference to radio systems operated by any FCC licensee. The City will consider applications for converged LMR Public Safety/Cellular implementations on a case-by-case basis.

The City operates a legacy three-site, twenty-five channel 800 MHz simulcast trunked public safety radio system for first responder communications. A system update, increasing the number of sites to seven and the number of channels to thirty, is currently being implemented and slated for a June 2025 cutover. The City's Department of Emergency Communications, Preparedness and Response (DECPR) has responsibility for the day-to-day operation, maintenance and management of the public safety radio system.

This document is intended to provide guidance to building owners and developers who are contemplating projects in the City that are required to meet the requirements of NFPA 1221



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2019, and to DAS system installation firms operating in the City and installing NFPA 1221 2019 compliant systems to meet the City's Emergency Services Communications code requirements.

Summary of Requirements for Owners

When the NFPA 1 Fire Code and the International Building Code, as adopted by City of Richmond, require reliable in-building public safety radio system coverage:

All commercial, multi-unit residential, governmental and educational occupancies must have reliable in-building public safety radio communications coverage that meets the requirements of NFPA 1221 2019, and the radio coverage requirements set forth by the City in Table 1, for the City 800 MHz radio system. BDA/DAS systems installed to satisfy radio coverage requirements shall also adhere to the system technical parameters provided in Appendix A for the City 800 MHz radio system.

Table 1 – City of Richmond Radio Coverage Requirements

| | |
|---|--|
| <u>Inbound signal strength</u> | <u>A minimum inbound signal strength of -90 dBm shall be provided throughout the coverage area for the City of Richmond 800 MHz system.</u> |
| <u>Outbound signal strength</u> | <u>A minimum outbound signal strength of -90 dBm shall be provided throughout the coverage area for the City of Richmond 800 MHz system.</u> |
| <u>Balanced uplink/downlink path operation</u> | <u>All passive and active components used in the BDA/DAS shall provide equal uplink/downlink levels of insertion loss, passive gain or active gain.</u> |
| <u>Voice audio quality</u> | <u>A minimum voice audio quality of DAQ 3.4 shall be provided throughout the coverage area for the City of Richmond 800 MHz system. DAQ 3.4 is defined as "Speech understandable with repetition only rarely required; some noise/distortion present."</u> |



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| | |
|--|---|
| <p><u>Coverage area reliability in critical areas</u></p> | <p><u>Fire command centers, fire alarm control panel locations, fire pump rooms, exit stairs, exit passageways, elevators, elevator lobbies, standpipe cabinets, sprinkler valve locations, areas of refuge and other areas deemed critical by the City shall be provided with 99% floor area reliability coverage for the City of Richmond 800 MHz system.</u></p> |
| <p><u>Coverage area reliability in general building areas</u></p> | <p><u>All other interior levels and areas of the building not defined as critical shall have 90% floor area reliability coverage for the City of Richmond 800 MHz system.</u></p> |

Occupancies that meet public safety radio coverage reliability requirements without radio communications enhancement systems:

In some occupancies, such as those with smaller footprints, or those located in close proximity to City transmission sites, it may be possible to achieve reliable public safety radio communications coverage throughout the occupancy and meet code requirements without the use of a radio communications enhancement system. Public safety radio coverage in these occupancies must meet the same radio coverage reliability requirements as those occupancies that require a radio communications enhancement system (See Table 1) for the City 800 MHz system. In cases such as these where a radio communications enhancement system is not required, the City will accept an independent certification of compliance with code requirements for reliable in-building public safety radio coverage.

- A firm qualified in the engineering and design of two-way radio communications enhancement systems shall be engaged to assist with this determination and provide the required certification for eligible occupancies.
- For buildings not equipped with two-way radio communications enhancement systems, testing for signal strength, audio quality and area coverage reliability compliance and certification must be performed when all construction and interior finishing work is complete, under full foliage conditions, between May 1 and October 1. Testing for this certification shall be conducted for the City 800 MHz radio system. Building owners/developers must submit all test documentation and a Certificate of Radio Coverage Compliance, signed and sealed by the engineer of record, stating that City 800 MHz public safety radio system coverage reliability within the occupancy meets the signal strength, audio quality and area coverage reliability requirements set forth in



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Table 1, and was tested in accordance with the provisions set forth in NFPA 1221 2019 A.11.3.9 (*Test Procedures*). DECPR will issue loaner portable radios to integrators upon request to accomplish the required DAQ testing.

- The Certificate of Radio Coverage Compliance shall be posted at the fire alarm control panel, or at the main electrical panel if no fire alarm control panel is present.

If testing determines that City 800 MHz public safety coverage reliability does not meet code requirements, a compliant radio communications enhancement system must be installed and tested prior to issuance of the certificate of occupancy.

Occupancies requiring radio communications enhancement systems to meet radio coverage reliability requirements:

In occupancies where two-way radio communications enhancement systems are required in order to meet code requirements for City 800 MHz radio system coverage, two-way radio communications enhancement systems and related equipment must meet all City, NFPA 1221 2019 and IBC 2018 requirements. More specifically, the requirements of Table 1, Appendix A and the following NFPA 1221 2019 sections are incorporated herein by reference:

- *Section 9.6 (Two Way Radio Communications Enhancement Systems)*
- *Section 11.3.9 (Test and Inspection of In-Building Two-Way Radio Enhancement Systems)*
- *Annex A.11.3.9 (Test Procedures)*
- NOTE: In cases where a City requirement is more stringent than a requirement defined in NFPA 1221, the City requirement shall take precedence.
- Systems shall be designed to provide compliant coverage area reliability for the City 800 MHz system.
- Building owners/developers must submit plans for the design of proposed two-way radio communications enhancement systems to DECPR staff for review, and approval of the selected donor site(s).
- Building owners/developers must apply for and obtain a Retransmission Authorization from DECPR prior to commissioning the two-way radio communications enhancement system. The Retransmission Authorization is required by the FCC and is the System operator's proof that the City has granted permission to operate equipment that uses radio frequencies



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licensed to the City¹. Provisional Retransmission Authorizations are issued for initial system activation, optimization and testing and are valid for one year from date of issuance. Final Retransmission Authorizations are issued upon successful commissioning of the system. Final Retransmission Authorizations remain valid indefinitely, provided that the Operator performs annual system maintenance and testing as required by NFPA 1221 2019 Section 11.3.9 (*Test and Inspection of In-Building Two-Way Radio Enhancement Systems*), and A.11.3.9 (*Annual Tests*), or unless otherwise rescinded by the City.

- Two-way communications enhancement systems shall be operated, maintained and tested annually in accordance with manufacturer's instructions, FCC rules and regulations, and the requirements of NFPA 1221 2019 Section 11.3.9 (*Test and Inspection of In-Building Two-Way Radio Enhancement Systems*), and A.11.3.9 (*Annual Tests*). Operators shall provide proof of annual system maintenance and testing upon request by the City.
- Equipment used by the two-way radio communications enhancement system must be type accepted by the FCC.
- The two-way radio communications enhancement system must be operated in accordance with FCC rules and regulations at all times.
- The two-way radio communications enhancement system shall not cause interference to City radio system or equipment, or to systems or equipment operated by any other FCC licensee.
- Building owners/developers must submit as-built documentation, in soft copy format (e.g., *.pdf, *.dwg, etc.) to DECPR after testing is completed.
- All active equipment (BDAs, Line Amplifiers, Remotes, etc.) shall be labeled with a "*To Report Problems with this Equipment*" label, providing the company name, contact name, telephone number, email address and business address of the party responsible for care and maintenance of the equipment.

Sensitive Compartmented Information Facilities (SCIF)

Sensitive Compartmented Information Facilities (SCIFs) are enclosed areas inside of occupancies specifically designed for handling of classified information. SCIFs are often found inside of buildings occupied by government and defense agencies and contractors.

Intelligence Community Standard Number 705-1, "Physical and Technical Standards for Sensitive Compartmented Information Facilities" requires that SCIF design and construction be

¹ See 47CFR90.219(b)(1)(i)



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compliant with the NFPA 1 Fire Code and the NFPA 101 Life Safety Code. Accordingly, in the City of Richmond, reliable first responder radio coverage must be provided inside of SCIFs. In-Building Two-Way Radio Communications Enhancement Systems must be provided if needed to ensure reliable first responder radio coverage inside of the SCIF.

In-Building Two-Way Radio Communications Enhancement Systems installed in SCIFs can be designed and equipped for automatic and manual activation to ensure that the security of the SCIF is not compromised by the operation of the coverage enhancement system. In such cases the following requirements apply:

- The In-Building Two-Way Radio Communications Enhancement System shall be equipped to automatically activate in the event of a building fire alarm smoke or heat detection event, manual pull station alarm, sprinkler system water flow detection, clean agent suppression discharge or any other fire alarm condition.
- The In-Building Two-Way Radio Communications Enhancement System shall be equipped with a clearly marked manual activation switch to allow manual activation of the coverage enhancement by first responders upon their arrival at the occupancy. The manual activation switch shall be located at the fire alarm annunciator or fire alarm control panel at the building's main entrance. Manual activation of the coverage enhancement system shall not require the use of special keys or other restrictions and shall not require the involvement of building staff. The automatic and manual activation capabilities shall be tested annually to ensure proper functionality.
- The SCIF area can be equipped with visual beacons or similar visual annunciator devices to alert staff working in the SCIF when the coverage enhancement system is active such that staff can take appropriate steps to protect sensitive information.



Initial Determination Process

- In all new buildings and existing buildings that are modified, minimum City 800 MHz radio signal strength must be provided. An applicant submits building plans to the City of Richmond Department of Planning & Development Review Bureau of Permits & Inspections for review.
- Permits & Inspections plan review staff will provide a plan comment as part of the building permit review stating that compliant public safety radio coverage is required for the occupancy, including the installation of a two-way radio communication enhancement system if necessary to meet code requirements.
- The applicant is directed to DECPR for additional information. This [Compliant Public Safety In-Building Two-Way Radio Communications Enhancement System Requirements](#) document is available for download from the DECPR web site.
- The applicant proceeds with the **Radio Communications Enhancement System Implementation Process** described below.

Radio Communications Enhancement System Implementation Process

The City has defined the following process for owners or developers planning new occupancies or modifications to existing occupancies that require a radio communications enhancement system to ensure operation of the City of Richmond public safety communication system inside buildings.

1. Conduct System Planning and Design

The applicant includes an NFPA 1221 2019, IBC 2018 and City compliant two-way radio communication enhancement system in the design requirements for the project, designed to provide compliant coverage for the City 800 MHz radio system. A qualified integrator or installation firm is retained by the developer to design, install and activate the two-way radio communications enhancement system as a part of the building project. DECPR provides consultation assistance to the integrator/installer and directs the selection of the donor site(s) for the proposed two-way radio communications enhancement system. The applicant must obtain a separate low-voltage permit to cover the installation of the two-way radio communication enhancement system. The fire alarm contractor is responsible for the fire alarm permit application, and integration of the radio communications enhancement system into the fire alarm supervisory notification/alarm panel.

2. Submit Retransmission Application

Integrator/installer completes a Retransmission Application for each BDA headend in the system design. Retransmission Applications must include the Low Voltage Permit Number



assigned for the work. Owner submits Retransmission Application(s) and proposed design documentation (e.g., system design diagrams, bill of materials, floor plan diagrams, etc.) to DECPR.

3. DECPR Creates Entry in FCC Signal Booster Database

DECPR utilizes the contact information provided in the Retransmission Application to create an entry for the two-way radio communications enhancement system in the FCC's Signal Booster database for the City frequencies. **Applicants, integrators and installers should not create entries in the FCC Signal Booster database for proposed two-way radio communications enhancement systems that will operate on frequencies licensed to the City.**

4. DECPR Reviews Application and Issues Provisional Retransmission Authorization

DECPR conducts a technical review of the proposed design. Upon approval of the design, DECPR issues a signed Provisional Retransmission Authorization to owner, which authorizes operation of the system for the purposes of installation, testing and optimization. The Provisional Retransmission Authorization is valid for a period of one year from date of issuance.

5. Perform System Installation

The integrator/installer proceeds with installation of the approved system in accordance with the project's plan and schedule. Substantial design changes from those specified in the initial design must be approved by DECPR (e.g., selection of a different donor site, selection of different model BDA, selection of a different donor antenna, additions or changes to number of line amplifiers in the design, and changes to the equipment room location in the building).

Updated DECPR review and approval is not required for minor changes that do not impact the number of active amplification devices used by the system or impact the donor site (e.g., changes to the number or location of indoor coverage antennas in the design).

The two-way radio communication enhancement system should not be activated for optimization and testing without prior DECPR authorization. DECPR may, at its sole discretion (typically for new BDAs that are less than a mile or two from the donor site), require that an initial desense test be conducted prior to initial activation to ensure that no harmful interference occurs to the City's 800 MHz radio system. The purpose of the desense test is to confirm that the new BDA does not degrade the RX (receive) performance at the donor site. This test is performed by the COR's technical staff, or the COR's vendor technician.

Integration with supervisory notification/alarm panel(s) shall comply with the requirements of NFPA 1221 2019 9.6.13 (System Monitoring) and must be completed prior to fire alarm and two-way radio communication enhancement system testing.



6. Perform Pre-Commissioning Activation and Optimization

Integrator/installer posts the Provisional Retransmission Authorization at the headend location(s). The integrator/installer notifies DECPR staff when ready to activate the system for the first time.

The integrator/installer conducts system activation and optimization. DECPR will issue loaner radios to integrators for system commissioning and testing upon request.

7. Perform Fire Alarm/Radio Communications Enhancement System Testing

The integrator/installer coordinates scheduling of initial DECPR BDA system inspection and testing with DECPR. DECPR shall inspect the system for the following criteria:

- Compliance with NFPA installation requirements
- Donor antenna orientation
- Grounding, bonding and general workmanship
- Actual signal strength and DAQ in the occupancy consistent with integrator's test results submittal
- Coverage reliability
- Proper commissioning, testing and as-built documentation
- Fire alarm control panel integration
- Donor site desense

Upon successful completion of testing, DECPR staff will affix a DECPR inspection sticker to the BDA equipment to indicate completion of DECPR testing to Fire Chief's Office staff. The BDA system and fire alarm control panel integration will then receive final inspection by members of the Fire Chief's Office.

8. Submit As-Built Documentation

The integrator/installer provides test results and full system as-built documentation to DECPR in soft copy format (e.g., *.pdf, *.dwg, etc.). DECPR issues a Final Retransmission Authorization. The Final Retransmission Authorization must be posted at all headend location(s). DECPR adds the as-built documentation to the system archives.

9. Issue Certificate of Occupancy

Richmond Department of Planning & Development Review Bureau of Permits & Inspections issues a Certificate of Occupancy after all requirements for occupancy are met, including the following:



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- Successful DECPR and Fire Chief's Office inspection
- Receipt of required documentation
- Posting of Final Retransmission Authorization(s) at the system headend(s)
- Posting the "*To Report Problems with this Equipment*" label providing the company name, contact name, telephone number, email address and business address of the party responsible for care and maintenance of the equipment on all active system components

10. Annual System Testing and Maintenance

The building owner retains services of a qualified firm to conduct annual system preventive maintenance and assist with annual testing. The building owner coordinates annual testing of the two-way radio communications enhancement system with annual testing of other fire alarm and fire safety systems. Annual testing of two-way radio communications enhancement systems shall be performed in accordance with the requirements of NFPA 1221 2019 Section 11.3.9 (*Test and Inspection of In-Building Two-Way Radio Enhancement Systems*), and A.11.3.9 (*Annual Tests*).

Detailed protocols of the annual tests will be submitted to DECPR within 30 days of completion.



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Sample Retransmission Authorization



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CITY OF RICHMOND, VIRGINIA 800 MHz RETRANSMISSION AUTHORIZATION

AUTHORIZATION NUMBER: FRA-YYYYMM-SBNNNNNNN

The City of Richmond, Virginia (the City) hereby grants authorization to name of operator (Operator) to operate a Two-Way Radio Communications Enhancement System (the System) on frequencies licensed to the City by the Federal Communications Commission (FCC) at the following location:

Site Name: site name
Site Address: street, city, state, zip
Latitude: latitude Longitude: longitude
FCC Booster ID: FCC Booster ID
Site Contact: site contact

This Retransmission Authorization is subject to the following conditions:

1. Retransmission Authorizations remain valid indefinitely, provided that the Operator performs annual system maintenance and testing as required by NFPA 1221 2019 and unless otherwise rescinded by the City. This Retransmission Authorization shall be posted conspicuously at the BDA headend location.
2. The System shall be operated, maintained and tested annually in accordance with manufacturer's instructions, FCC rules and regulations, and the requirements of NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems, (National Fire Protection Association 2019). Operator shall provide proof of annual system maintenance and testing upon request by the City.
3. The System shall not cause interference to radio systems or equipment operated by the City or any other FCC licensee.
4. Operator shall promptly resolve any interference that occurs to radio systems or equipment operated by the City or any other FCC licensee, up to and including deactivation of the System, if necessary, until such time that the interference is corrected.
5. In the event of an outage of the System, Operator shall notify the City of Richmond Fire Chief in accordance with the regulations, policies and procedures for reporting any fire alarm/fire safety system outage. In parallel, Operator will notify DECPR, Jackie L. Crofts, Deputy Director of Technology, City of Richmond, VA, via email at Jackie.Crofts@rva.gov or via phone at 804-646-8457
6. Operator shall provide access to the System for inspection upon request by the City or the FCC.
7. A separate Retransmission Authorization shall be obtained for each headend location used in the system design and posted conspicuously with the headend equipment.
8. The City, as FCC licensee for its respective frequencies, reserves the right to terminate this Retransmission Authorization at their sole discretion.

Date: date issued

Jackie L. Crofts, DECPR Deputy Director of Technology, City of Richmond, VA

3516 North Hopkins Road – Richmond, Virginia 23224 – 804-646-5911
rva.gov/911 & rva.gov/emergency-management



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Sample Retransmission Application

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800 MHz RETRANSMISSION APPLICATION

INSTRUCTIONS: Provide all information requested on the Retransmission Application. Include system design diagrams, bill of materials and floor plan diagrams as separate attachments. Complete a separate form for each BDA headend in the design. The information provided will be used to create a record for the proposed system in the FCC Signal Booster registry in accordance with FCC rules. A Provisional Retransmission Authorization will be issued for system startup upon review and approval by the City staff. Systems shall not be activated prior to issuance of the Provisional Retransmission Authorization. The City, at its sole discretion, may require an initial ~~discovery~~ test when the system is activated for the first time, to ensure that no harmful interference is occurring to nearby donor sites. The Provisional Retransmission Authorization will indicate if the initial ~~discovery~~ test is required. Submit completed application electronically via email to Jackie L. Crofts, DECPR Deputy Director of Technology, City of Richmond, VA, Jackie.Crofts@rva.gov For questions, contact via email or phone at 804-646-8457.

1. SITE INFORMATION

Site Name: _____

Site Address: _____

Low Voltage Permit Number (Issued by the City of Richmond Division of Permits and Inspections): _____

Site Description (type of construction, number of floors, interior square footage): _____

Site Latitude and Longitude: _____

| | | |
|-----------------------------------|--------------|--------------------------------------|
| BDA Manufacturer and Model: _____ | Class: _____ | Total System Delay in μ s: _____ |
|-----------------------------------|--------------|--------------------------------------|

BDA Headend Location: _____

| | |
|---|---|
| Number of Line Amplifiers or Fiber Remotes: _____ | Line Amplifier/Fiber Remote Manufacturer and Model: _____ |
|---|---|

Type of System: 800 MHz Public safety only Multiple carrier neutral host Other (describe below) _____

2. BUILDING/DEVELOPMENT OWNER CONTACT INFORMATION

Owner: _____

Owner address: _____

| | |
|-------------------------|--------------|
| Point of contact: _____ | Email: _____ |
|-------------------------|--------------|

| | |
|-------------------|---------------------|
| Work phone: _____ | Mobile phone: _____ |
|-------------------|---------------------|

3. SITE ACCESS OR TECHNICAL CONTACT INFORMATION (will provide access for inspections and testing)

Company: _____

Address: _____

| | |
|-------------------------|--------------|
| Point of contact: _____ | Email: _____ |
|-------------------------|--------------|

| | |
|-------------------|---------------------|
| Work phone: _____ | Mobile phone: _____ |
|-------------------|---------------------|

4. SYSTEM INTEGRATOR/INSTALLER/MAINTAINER

Company: _____

Address: _____

| | |
|-------------------------|--------------|
| Point of contact: _____ | Email: _____ |
|-------------------------|--------------|

| | |
|-------------------|---------------------|
| Work phone: _____ | Mobile phone: _____ |
|-------------------|---------------------|

5. PREPARER SIGNATURE AND DATE:

Signature: _____ Date: _____

Print name and title: _____



Appendix A - System Technical Criteria

Public safety agencies utilize the existing City's three-site, twenty-five channel Motorola 800 MHz simulcast trunked radio system when operating in the City of Richmond. A System update is being implemented by the City, with the official cutover targeted for June 2025. Among other changes, the System update will add 5 more channels to the existing sites and add four more simulcast sites.

Integrators shall design and configure BDA/DAS equipment to pass the frequencies that are currently used in the City's Motorola 800 MHz simulcast trunked radio system and the frequencies that will be used in the City's updated P25 system. Each system shall be designed and configured for balanced uplink/downlink path operation. All passive and active components used in the BDA/DAS shall provide equal uplink/downlink levels of insertion loss, passive gain or active gain. BDA equipment deployed in the City of Richmond shall be configured for Class B broadband operation to ensure compliance with the City's $\leq 8\mu\text{s}$ propagation delay requirement. Channelized systems are permitted, provided that the propagation delay does not exceed $8\mu\text{s}$.

The following system technical data is provided to assist two-way radio communications enhancement system designers.

1. **Radio coverage requirements:** see Table 1.
2. **Isolation:** A minimum of 20 dB isolation, or greater if required by the equipment manufacturer, shall be provided between the donor antenna and the service antennas inside of the building.
3. **Delay:** Total propagation delay introduced by the system shall not exceed $8\mu\text{s}$.
4. **Frequency Configuration:**

Table 2 - Class B 800 MHz Frequency Configuration

| Band | BDA Downlink | BDA Uplink |
|---------|--------------|-------------|
| 800 MHz | 806-815 MHz | 851-860 MHz |



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Table 3 - System Frequencies

| System | Legacy 3-Site System Channel ID | New P25 7-Site System Channel ID | System Downlink | System Uplink |
|------------------|--|---|------------------------|----------------------|
| City of Richmond | N/A | 1 | 857.0875 | 812.0875 |
| City of Richmond | N/A | 2 | 857.5375 | 812.5375 |
| City of Richmond | N/A | 3 | 856.5375 | 811.5375 |
| City of Richmond | N/A | 4 | 859.5375 | 814.5375 |
| City of Richmond | N/A | 5 | 856.0875 | 811.0875 |
| City of Richmond | 2 | 6 | 853.8250 | 808.8250 |
| City of Richmond | 1 | 7 | 853.9500 | 808.9500 |
| City of Richmond | 4 | 8 | 853.5125 | 808.5125 |
| City of Richmond | 21 | 9 | 853.9750 | 808.9750 |
| City of Richmond | 3 | 10 | 853.7000 | 808.7000 |
| City of Richmond | 6 | 11 | 853.2375 | 808.2375 |
| City of Richmond | 22 | 12 | 853.3125 | 808.3125 |
| City of Richmond | 23 | 13 | 853.0750 | 808.0750 |
| City of Richmond | 5 | 14 | 853.4125 | 808.4125 |
| City of Richmond | 7 | 15 | 853.1250 | 808.1250 |
| City of Richmond | 10 | 16 | 852.7250 | 807.7250 |
| City of Richmond | 9 | 17 | 852.8625 | 807.8625 |
| City of Richmond | 12 | 18 | 852.3375 | 807.3375 |
| City of Richmond | 8 | 19 | 852.9625 | 807.9625 |
| City of Richmond | 11 | 20 | 852.6125 | 807.6125 |
| City of Richmond | 24 | 21 | 852.0500 | 807.0500 |
| City of Richmond | 14 | 22 | 852.0875 | 807.0875 |
| City of Richmond | 16 | 23 | 851.7875 | 806.7875 |
| City of Richmond | 13 | 24 | 852.1875 | 807.1875 |
| City of Richmond | 15 | 25 | 851.9125 | 806.9125 |
| City of Richmond | 19 | 26 | 851.2375 | 806.2375 |
| City of Richmond | 18 | 27 | 851.3875 | 806.3875 |
| City of Richmond | 25 | 28 | 851.0375 | 806.0375 |
| City of Richmond | 17 | 29 | 851.6625 | 806.6625 |
| City of Richmond | 20 | 30 | 851.1375 | 806.1375 |



5. Site Information:

Table 4 - Site Information

| City of Richmond 800 MHz Simulcast Site Locations | | | | | | | | |
|---|--------------|--------------|-------|-------|--------------------------|------------|------|---------|
| Site | Lat | Lon | AMSL' | HTC' | TX Antenna | Gain (dBd) | Az | ERP (W) |
| City Hall (Legacy/P25) | 37 32 28.0 N | 77 25 59.0 W | 169.9 | 342.0 | CC807-08-T1 | 8.0 | --- | 148.0 |
| East End (P25-Only) | 37 31 43.4 N | 77 24 02.0 W | 127.6 | 244.0 | CC807-08-T1 | 8.0 | --- | 159.0 |
| FS 23 (P25-Only) | 37 29 57.5 N | 77 30 26.4 W | 215.8 | 312.0 | BMR12-H (DT 1.0) | 15.4 | 75° | 591.0 |
| FS 25 (Legacy/P25) | 37 32 21.7 N | 77 33 36.7 W | 329.0 | 164.3 | SE419-SWBP2LDF (D00) | 10.0 | 0° | 241.0 |
| RIC Hopkins Prime (Legacy/P25) | 37 29 57.0 N | 77 27 19.0 W | 160.1 | 376.5 | SC412-HF2LDF (D02-E5765) | 11.5 | --- | 251.0 |
| RIC Port of Richmond (P25-Only) | 37 27 53.4 N | 77 25 21.3 W | 46.9 | 179.0 | SE4192-SWBP4LDF(D00) | 12.5 | 335° | 437.0 |
| WTVR (P25-Only) | 37 33 58.6 N | 77 28 34.0 W | 206.0 | 274.0 | CC807-08-T1 | 8.0 | --- | 170.0 |

Appendix B – 47CFR90.219, FCC rules governing use of Signal Boosters

§90.219 Use of signal boosters.

This section contains technical and operational rules allowing the use of signal boosters in the Private Land Mobile Radio Services (PLMRS). Rules for signal booster operation in the Commercial Mobile Radio Services under part 90 are found in §20.21 of this chapter.

(a) *Definitions.* The definitions in this paragraph apply only to the rules in this section.

Class A signal booster. A signal booster designed to retransmit signals on one or more specific channels. A signal booster is deemed to be a Class A signal booster if none of its passbands exceed 75 kHz.

Class B signal booster. A signal booster designed to retransmit any signals within a wide frequency band. A signal booster is deemed to be a Class B signal booster if it has a passband that exceeds 75 kHz.

Coverage area of a PLMRS station. All locations within the normal reliable operating range (service contour) of a PLMRS station.

Deploy a signal booster. Install and/or initially adjust a signal booster.



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Distributed Antenna System (DAS). A network of spatially separated antenna nodes connected to a common source via a transport medium that provides wireless service within a geographic area or structure.

Operate a signal booster. Maintain operational control over, and responsibility for the proper functioning of, a signal booster.

Signal booster. A device or system that automatically receives, amplifies, and retransmits signals from wireless stations into and out of building interiors, tunnels, shielded outdoor areas and other locations where these signals would otherwise be too weak for reliable communications. Signal booster systems may contain both Class A and Class B signal boosters as components.

(b) *Authority to operate.* PLMRS licensees for stations operating on assigned channels higher than 150 MHz may operate signal boosters, limited to the service band for which they are authorized, as needed anywhere within the PLMRS stations' service contour, but may not extend the stations' service contour.

(1) PLMRS licensees may also consent to operation of signal boosters by non-licensees (such as a building owner or a signal booster installation contractor) within their service contour and across their applicable frequencies, but must maintain a reasonable level of control over these operations in order to resolve interference problems.

(i) Non-licensees seeking to operate signal boosters must obtain the express consent of the licensee(s) of the frequencies for which the device or system is intended to amplify. The consent must be maintained in a recordable format that can be presented to an FCC representative or other relevant licensee investigating interference.

(ii) Consent is not required from third party (unintended) licensees whose signals are incidentally retransmitted. However, signal booster operation is on a non-interference basis and operations may be required to cease or alter the operating parameters due to a request from an FCC representative or a licensee's request to resolve interference.

(2) [Reserved]

(c) *Licensee responsibility; interference.* PLMRS licensees that operate signal boosters are responsible for their proper operation, and are responsible for correcting any harmful interference that signal booster operation may cause to other licensed communications services. Normal co-channel transmissions are not considered to be harmful interference. Licensees are required to resolve interference problems pursuant to §90.173(b). Licensees shall act in good faith regarding the operation of signal boosters and in the resolution of



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interference due to signal booster operation. Licensees who are unable to determine the location or cause of signal booster interference may seek assistance from the FCC to resolve such problems.

- (d) *Deployment rules.* Deployment of signal boosters must be carried out in accordance with the rules in this paragraph.
- (1) Signal boosters may be used to improve coverage in weak signal areas only.
 - (2) Signal boosters must not be used to extend PLMRS stations' normal operating range.
 - (3) Signal boosters must be deployed such that the radiated power of each retransmitted channel, on the forward link and on the reverse link, does not exceed 5 Watts effective radiated power (ERP).
 - (4) Class B signal boosters may be deployed only at fixed locations; mobile operation of Class B signal boosters is prohibited after November 1, 2014.
 - (5) Class B signal booster installations must be registered in the FCC signal booster database that can be accessed at the following URL: www.fcc.gov/signal-boosters/registration.
 - (6) Good engineering practice must be used in regard to the radiation of intermodulation products and noise, such that interference to licensed communications systems is avoided. In the event of harmful interference caused by any given deployment, the FCC may require additional attenuation or filtering of the emissions and/or noise from signal boosters or signal booster systems, as necessary to eliminate the interference.
 - (i) In general, the ERP of intermodulation products should not exceed -30 dBm in 10 kHz measurement bandwidth.
 - (ii) In general, the ERP of noise within the passband should not exceed -43 dBm in 10 kHz measurement bandwidth.
 - (iii) In general, the ERP of noise on spectrum more than 1 MHz outside of the passband should not exceed -70 dBm in a 10 kHz measurement bandwidth.
 - (7) Signal booster passbands are limited to the service band or bands for which the operator is authorized. In general, signal boosters should utilize the minimum passband that is sufficient to accomplish the purpose. Except for distributed antenna systems (DAS) installed in buildings, the passband of a Class B booster should not encompass both commercial services (such as ESMR and Cellular Radiotelephone) and part 90 Land Mobile and Public Safety Services.
- (e) *Device Specifications.* In addition to the general rules for equipment certification in §90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.
- (1) The output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel.



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- (2) The noise figure of a signal booster must not exceed 9 dB in either direction.
- (3) Spurious emissions from a signal booster must not exceed -13 dBm within any 100 kHz measurement bandwidth.
- (4) A signal booster must be designed such that all signals that it retransmits meet the following requirements:
 - (i) The signals are retransmitted on the same channels as received. Minor departures from the exact provider or reference frequencies of the input signals are allowed, *provided that* the retransmitted signals meet the requirements of §90.213.
 - (ii) There is no change in the occupied bandwidth of the retransmitted signals.
 - (iii) The retransmitted signals continue to meet the unwanted emissions limits of §90.210 applicable to the corresponding received signals (assuming that these received signals meet the applicable unwanted emissions limits by a reasonable margin).
- (5) On or after March 1, 2014, a signal booster must be labeled to indicate whether it is a Class A or Class B device, and the label must include the following advisory
 - (1) In on-line point-of-sale marketing materials,
 - (2) In any print or on-line owner's manual and installation instructions,
 - (3) On the outside packaging of the device, and
 - (4) On a label affixed to the device:

“WARNING. This is NOT a CONSUMER device. It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLERS. You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device. You MUST register Class B signal boosters (as defined in 47 CFR 90.219) online at www.fcc.gov/signal-boosters/registration. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation.”

[78 FR 21564, Apr. 12, 2013]