

BROWARD COUNTY BOARD OF RULES AND APPEALS

1 N. University Drive, Suite 3500B, Plantation, FL 33324
P: 954-765-4500 | F: 954-765-4504 broward.org/CodeAppeals

To: Members of the Committee to Address Uniform Procedures for Installation of Bi-Directional Amplifiers (BDA)

D. Rice, P.E.	B. Bowers	M. Bray	J. DeZayas	R. Dinello	J. Franklin
K. Grams	L. Hastings	B. Higdon	W. Keys	H. Melamed	J. Preston
M. Sheehan	R. Taylor	A. Zackria			

From: Bryan Parks, Chief Fire Code Compliance Officer
Ken Castronovo, Chief Electrical Code Compliance Officer

Date: February 24, 2020

Subj: BDA Committee to Discuss Agenda Items

The Chairman of the BDA Committee, Mr. Dave Rice, P.E., has called for a meeting of the BDA Committee on February 24, 2020 at 1:30pm at the Coconut Creek Community Center, 1100 Lyons Road, Coconut Creek, FL 33063. The latest issues concerning Bi-Directional Amplifiers, will be discussed.

Chairman Welcoming Remarks

New Member(s): **Ms. Lori Hastings**, Assistant District Chief, BSO Department of Fire Rescue and Emergency Services
Mr. Jorge Castano, Deputy Fire Marshal & Fire Code Official, City of Hollywood Fire Rescue

Roll Call

Acceptance of September 17, 2019 Meeting Minutes

Item 1: Send Guidelines to the Broward County Board of Rules and Appeals for approval

Item 2: Education Program

Item 3: Technical Issue: NFPA Definition Of “Riser Cable”

Item 4: Technical Issue: Define the Requirements of NFPA 72 (2019), NFPA 1221 (2019)

Item 5: Technical Issue: Discuss “Coaxial Cable” Installed in a “Flexible Metal Conduit”

Schedule Next Meeting

Adjournment

Sunshine Law Reminder: Advisory Board members cannot communicate with each other on a possible committee or Board topic outside of a public meeting, per State statute.



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MEETING OF THE COMMITTEE TO ADDRESS UNIFORM PROCEDURES FOR INSTALLATION OF BI-DIRECTIONAL AMPLIFIERS

SUMMARY
September 17, 2019

Call to order:

Chair David Rice, P.E. called a published meeting of the Broward County Board of Rules and Appeals Committee to Address Uniform Procedures for Installation of Bi-Directional Amplifiers to order at 1:35pm.

The roll was called, and the following members were present:

Present:

Mickey Bray	Jonathan Franklin	Abbas Zackria
Thomas DiBernardo	David Rice, P.E.	
Robert "Bob" Dinello	Robert Taylor	

Staff: Bryan Parks, Chief Fire Code Compliance Officer
Kenneth Castronovo, Chief Electrical Code Compliance Officer

The BDA Committee did not reach a quorum for the meeting.

With no quorum, no motions could be made, so Chair David Rice, P.E., R.C. Engineering, Inc., proposed that the members of the BDA Committee that were present have a discussion with the public about the agenda items. Particularly Item 2 (Discuss "Guidelines Draft Rev. 1") and Item 3 (Discuss "Sample Drawings Draft Rev. 1") following the drafts for the following items:

- Broward County Two-Way Radio Communications Enhancement Systems (BC RCES)
- Two-Way Radio Communications Enhancement System – Sample Office Building Drawing

Chair Rice encouraged the public to submit their comments and suggestions about the drafts to Bryan Parks, Chief Fire Code Compliance Officer, Broward County Board of Rules and Appeals, and/or Kenneth Castronovo, Chief Electrical Code Compliance Officer, Broward County Board of Rules and Appeals.

Adjournment:

Having no further business to go before the committee, the meeting adjourned at 3:34pm.

Item 1:

Send Guidelines to the Broward County
Board of Rules and Appeals for approval

Broward County Board of Rules and Appeals
Two-Way Radio Communications Enhancement Systems
BORA RCES Guidelines

For Review and Approval by the

BDA Committee
2020

Draft Edition

DRAFT EDITION
2020-02-24 Rev 2

Broward County Board of Rules and Appeals
Two-Way Radio Communications Enhancement Systems
BORA RCES Guidelines

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Part 2.	Recommended Check Lists for AHJ's:
	A. Recommended Checklists for NFPA 72 (2013)
	B. Recommended Checklists for NFPA 72 (2016), NFPA 1221 (2016)
	C. Recommended Checklists for NFPA 72 (2019), NFPA 1221 (2019)
Part 3.	Additional Information Attachments

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Broward County Board of Rules and Appeals
Two-Way Radio Communications Enhancement Systems
BORA RCES Guidelines

Part 1. Overview

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1.1 Purpose

A “Two-Way Radio Communications Enhancement System” (RCES) gives fire departments and law enforcement a reliable in-building communication system without detrimentally impacting the surrounding community’s Public Radio Communication Systems.

The purpose of these guidelines is to provide the designers, manufacturers, installers, inspectors, and FCC License Holders the tools to properly design, permit, install, and inspect a fully functional in-building communication enhancement system that meets the state and local codes for Broward County, Florida.

These are guidelines only and are not intended to be code items.

Team Effort

RF Requirements

Building Code and Life Safety Requirements

Standards

Standards and Codes

- FCC
- TIA/ANSI
- Motorola R56
- IEEE

- FFPC, FBC
- NFPA 70, NFPA 72, NFPA 780

Design

Design

- RF Engineer
- (May or may not be a PE)

- Registered Architect, Professional Engineer
- Electric

Installation

Installation

- System Integrator
- (May or may not be a contractor)

- Electrician and other contractors

Inspection

Inspection

- FCC AHJ

- Fire AHJ
- Electric AHJ
- Elevator AHJ
- Building/Structural AHJ

Communication System Operation

System meets Safety Codes and Standards

Final Result

Public System

Two-Way Radio Communication Enhancement System

Operates reliably

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1.2 Background

Each municipality has a public emergency Two-Way Radio Communications System for use by the fire department and law enforcement. These two-way radio systems generally work in open spaces without problems. However, these two-way radio systems do not always work inside buildings. Most buildings now require a signal repeater system located in the building to amplify the radio signal to allow the two-way radio system to work. These systems are known as “Two-Way Radio Communications Enhancement Systems (RCES)” or “Bi-Directional Amplifier Systems” (BDA).

When these systems are not properly designed, installed, inspected, and maintained, then major communication problems can occur inside and outside of the building. One faulty system may take down the Public Safety Radio Communication System in a large part of a municipality. This faulty system would prohibit the fire department and law enforcement from communicating through their two-way radio system.

In 2015, BDA Systems installed in high rise buildings in the cities of Aventura and Hallandale Beach caused significant interference with the Broward County’s Public Safety Radio System. The Hallandale Beach System was improperly adjusted after the inspections were completed. Once the problems were identified, the building systems were immediately taken off-line, repaired, and re-inspected. Broward County then asked Broward County Board of Rules and Appeals (BORA) to investigate the problems associated with the faulty installation and to review the existing codes and procedures to attempt to prevent this problem from occurring again.

BORA started up a temporary committee to address these problems. The committee found the following:

1. The state and local codes, Florida Building Codes (FBC), Florida Fire Prevention Code (FFPC), and NFPA 72, if followed, were sufficient and did not require any changes.
2. The problem was a procedural one. All three (3) codes required that the installation shall be permitted and the AHJ’s be notified. A new code section was added to the Florida Building Code (FBC), Broward County Edition, Chapter 1. This new section 118 set forth procedures requiring AHJ notification, among other requirements.

The temporary committee was made a permanent committee in 2018 to address ongoing Two-Way Radio Communications Enhancement Systems problems. The technology is moving at a faster pace than the codes are able to address.

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1.3 Codes and Requirements for Broward County

As of January 1, 2018, the following codes have been in effect:

Florida Statute (FS)633.202(1)

Adopts the FFPC

Florida Statute (FS)633.202(18)

This statute pertains to high-rise buildings.

Florida Building Code (FBC), Broward County Edition, Chapter 1, Sixth Edition (2017)

Section 118 Two-Way Radio Communication Enhanced Public Safety Signal
Booster Systems

Florida Fire Prevention Code (FFPC) Sixth Edition (2017)

NFPA 1 Fire Code (2015)

Section 1.4 Equivalencies
Section 2.2 Referenced Publications
NFPA 70, NFPA 72, NFPA 780, (NFPA 1221 Not enforceable)
Section 11.10 Two-Way Radio Communications Enhancement System
when required by AHJ

NFPA 70 (NEC) (2014)

Section 90.7
Article 100 Definitions
Section 110.2 Approval (UL, etc.)
Section 100.2(B) Approval (UL, etc.)

NFPA 72 (Fire Alarm) (2013)

Chapter 10 Fundamentals
Section 12.4 Pathway Survivability
Section 14.4.10 In-Building Emergency Radio Communication System
Section 24.3.6 Pathway Survivability
Section 24.5.2 Two-Way Radio Communications Enhancement Systems
Annex A14.4.10.3 DAQ
Annex A14.4.10.5 DAQ

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1.3 Codes and Requirements for Broward County (cont.)

Codes and Standards Available:

NO.	Description	Issue Date								
		2013	2014	2015	2016	2017	2018	2019	2020	2021
NFPA 70	Electric		FL			*				
NFPA 72	Fire Alarm	FL			*			*		
NFPA 780	Lightning Protection Systems		#			*				
NFPA 1221	Em Service Comm System				*			*		
UL 2524	2-way EM Comm						*			
FL – Adopted by Florida <u># - Adopted by Florida for hospitals, nursing homes, schools only</u> * - Code Now Available, but not adopted by Florida State of Florida is up to six (6) years behind in adopting codes.										

Other Codes and Standards Available, but not adopted by Florida:

NO.	Description	Issue Date								
		2013	2014	2015	2016	2017	2018	2019	2020	2021
IFC	International Fire Code IFC/ICC			*			*			
IEEE 1692	Institute of Electric and Electronic Engineers Guide for the Protection of Communication Installations from Lightning Effects 2011									
Motorola R56	Standards and Guidelines 2015 For Communications Sites Chapter 4 Exterior Grounding Chapter 5 Interior Grounding Chapter 7 Surge Protection Devices Chapter 9 Equipment Installation 9.9.8 RF Cabling									
ANSI/TIA	569, 607 Pathways, Grounding									

Other Guidelines:

City of Fort Lauderdale	Communications Systems	BDA Guidelines 2020-02-07
Broward County	RESC	BDA Guidelines 2019

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1.3 Codes and Requirements for Broward County (cont.)

Optional Codes and Dates

The State of Florida, through the FFPC (2017), Chapter 1, Section 1.4, allows the Two-Way Radio Communications Enhancement System Engineer of Record to design the system with present or newer codes, if acceptable by the AHJ, as shown below:

The design engineer shall select one and use only one of the following three options:

NFPA 72 (2013)

NFPA 72 (2016) and NFPA 1221 (2016)

NFPA 72 (2019) and NFPA 1221 (2019)

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1.3 Codes and Requirements for Broward County (cont.)
Code Comparison

The State of Florida has adopted NFPA (2013). The Engineer of Record (EOR) may select to design the system using NFPA 72 (2016), NFPA 1221 (2016), or NFPA 72 (2019), NFPA 1221 (2019).

Main differences between codes and dates:

	NFPA 72 (2013)
1	Feeder and riser cables shall be plenum-rated and have a <u>Pathway Survivability- Level 1, 2, Or 3.</u> Riser Cables shall be routed through a two-hour-rated enclosure (NFPA 72-24.3.6.8).
2	<u>BDA Systems shall be protected by</u> a Lightning Protection System <u>only</u> if a Lightning Protection System is existing. <u>The Lightning Protection System</u> shall comply with NFPA 780.

	NFPA 72 (2016), NFPA 1221 (2016)
1	Feeder and riser cables shall be plenum-rated and have a <u>Pathway Survivability- Level 1, 2, Or 3.</u> Riser Cables shall be routed through an enclosure that matches the building's fire rating (NFPA 1221-9.6.2).
2	<u>BDA Systems shall be protected by</u> a Lightning Protection System that complies with NFPA 780. A new Lightning Protection System shall be installed if one does not exist <u>and</u> the system shall comply with NFPA 780. (NFPA 1221-9.6.3)

	NFPA 72 (2019), NFPA 1221 (2019)
1	<u>Pathway Survivability has been removed from NFPA 1221. Backbone cables are the only cables to be in an enclosure that matches the building's fire rating.</u> (NFPA 1221-9.6.2.3) <u>See the definition of "Backbone" in NFPA 1221-3.3.10</u>
2	<u>BDA Systems shall be protected by</u> a Lightning Protection System that complies with NFPA 780. A new Lightning Protection System shall be installed if one does not exist <u>and</u> the system shall comply with NFPA 780. (NFPA 1221-9.6.3)

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1.4 Authorities Having Jurisdiction (AHJ)

The AHJ is defined as: “An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation or a procedure”.

In Broward County, Florida, the AHJ’s are as follows for the installation of Two-Way Radio Communications Enhancing Systems:

Local Municipalities (City or County)

1. Chief Electrical Inspector
NFPA 70
2. Fire Official
NFPA 72 (NFPA 1221 Option)
3. Broward County Elevator Inspection
FBC-30, FS 399, FAC 61C-5, ASME A17-1
4. FCC License Holder
 - A. Broward County Regional Emergency Services and Communication (RESC)
 - B. Fort Lauderdale
 - C. Coral Springs
 - D. Plantation
 - E. Hollywood
5. Building Inspector

Note: Work shall not start on any project until a permit has been issued and signed by each of the five (5) AHJ’s:

Electrical, Fire, Elevator, FCC License Holder, Building

Note: The Elevator AHJ may not be involved in all projects.

The system shall not be energized (including testing) until written authorization is obtained by the:

FCC License Holder

A building certificate of completion, or occupancy shall not be issued until the permit work is completed and signed off by each of the four (4) AHJ’s:

Electrical, Fire, FCC License Holder, Building

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1.5 Design

The Two-Way Radio Communications Enhancement System shall be designed by a Professional Engineer, licensed in the State of Florida. The Professional Engineer shall follow the Florida Statutes and the Florida Administrative code requirements for the system engineering process.

The FBC, Broward County Edition, Section 118 requires that the Professional Engineer have training and experience in Electrical Engineering.

Heat map drawings shall be prepared by the Professional Engineer or a Radio Frequency System Designer under the direct supervision of the Professional Engineer in accordance with FS and FAC requirements. Heat map drawings shall be prepared by a designer certified by the heat map software company. The drawings shall include the designer's name, certification level, the name of the heat map software company, software app name, and software app version.

The professional Engineer shall show on the drawings all applicable codes with corresponding dates:

The Professional Engineer shall be available for plan review and inspections if requested by the AHJ.

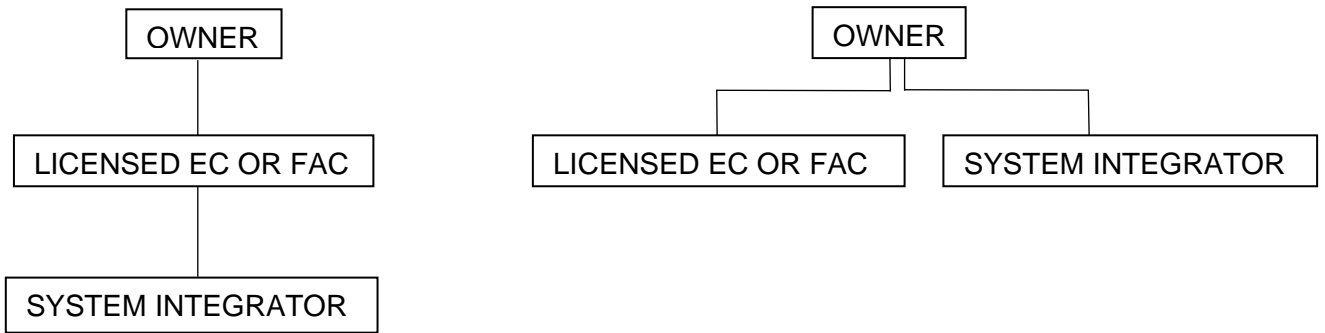
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1.6 Installation

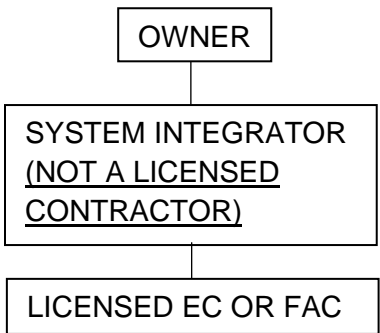
The installation shall be completed by a qualified Electrical Contractor or Fire Alarm Contractor. Contracting shall be in compliance with the State of Florida Electrical Contractor's Licensing Board (ECLB). This board is presently considering a code change. Contact the ECLB for the latest requirements.

Only a licensed Electrical Contractor, Fire Alarm Contractor, or RCESS Contractor (pending) can contract to install a system. A systems integrator, which is not a licensed contractor, cannot contract for the installation. (FAC 61G6)

Allowed



Not Allowed



Note: Never energize the system for any reason without first passing the FCC AHJ's Initial Inspection.

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1.7 Permitting

Record drawings, signed and sealed by a qualified Professional Engineer, shall be submitted to each AHJ for plan review and approval. The FCC AHJ (License Holder) shall provide a written acceptance prior to the review by the other AHJ's. The drawings shall be approved by all AHJ's prior to the start of any work.

Refer to the applicable Code Compliance Plan Review Checklist for the requirements of each AHJ.

1.8 Inspections

The contractor shall coordinate all inspections as required by the AHJ's.

Note: Never energize the system for any reason without first passing the FCC AHJ initial inspection.

Refer to the applicable Code Compliance Inspection Checklist for the requirements of each AHJ.

1.9 Final Acceptance

A Certificate of Occupancy or a Certificate of Completion for a building shall not be given until the Two-Way Radio Communications Enhancement System is approved by the Authority Having Jurisdiction. (Electric, Fire, Elevator where applicable, FCC License Holder, and Building)

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Broward County Board of Rules and Appeals
Two-Way Radio Communications Enhancement Systems
BORA RCES Guidelines

Part 2A. Recommended Checklists for NFPA 72 (2013)

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2A.1.1 NFPA 72 (2013) Plan Review - Fire

Plans shall include the following information:

- 1. Building owner and address
- 2. Scope of Work
- 3. Signature and seal of the Engineer of Record with experience and training in electrical engineering. The name, PE number, business name, CA number, address, and contact information shall be shown on the plans. The AHJ may require that the Engineer of Record provide evidence of experience and training in Electrical Engineering. (NFPA 72-10.5)
- 4. Applicable codes and edition dates
- 5. Building description showing building construction, building occupancy, total square footage, number of floors, total height of building (NFPA 1-1.7.12) (NFPA 72-7.4)
- 6. Floor plans showing device locations, fire-rated enclosures, conduit runs, and propagation modeling, etc. (NFPA 1) (NFPA 1-1.7.12) (NFPA 72-7.4)
- 7. Riser plans for systems (NFPA 1-1.7.12) (NFPA 72-7.4)
- 8. Specifications with manufacturer's parts numbers (NFPA 1-1.7.12) (NFPA 72-7.4)
- 9. Firewall penetration details, etc. (NFPA 1-12) (NFPA 1-1.7.12) (NFPA 72-7.4)
- 10. Identify the panel and circuit breaker; show panel location on plan (NFPA 1-1.7.12) (NFPA 72-7.4)
- 11. Show circuit breaker lock (NFPA 1-1.7.12) (NFPA 72-10.6.5.4)
- 12. Provide an information binder stored next to the BDA. Information shall include (NFPA 72-7.5):
 - (1) As-built drawings
 - (2) Manufacturer's data sheets and specs
 - (3) Heat maps with the final measured signal strength readings
 - (4) Final signal strength measurements (dB)
 - (5) Maintenance contract
 - (6) Broward County RESC, FCC AHJ (License Holders), all other approvals, and elevator variance letter, if applicable.
 - (7) Maintenance Repair Log
- 13. Pathway survivability level shall be 1, 2, or 3. For Level 1, all coaxial cables shall be in metal raceways. (NFPA 72-12.4)
- 14. The feeder and riser coaxial cables shall be rated as plenum cable. (NFPA 72-24.3.6.8.1.1)
- 15. Riser coaxial cables shall be routed through a 2-hour-rated enclosure. (NFPA 72-24.3.6.8.3)
- 16. Radio coverage shall be a minimum of 99% in critical areas, such as the fire command center(s), the fire pump room(s), exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the AHJ and 90% in general building areas. (NFPA 72-24.5.2.2)
- 17. Signal strength inbound shall be a minimum of -95 dBm. (NFPA 72-24.5.2.3.1)
Signal strength outbound shall be a minimum of -95 dBm. (NFPA 72-24.5.2.3.2)
Note: a signal strength of less than -90 dBm as shown on the plans has a high probability of failing the final inspection of DAQ 3.0 minimum.
See NFPA 72-14.4.10.3 Test Procedures; Recommend -90 dBm.
- 18. Isolation shall be a minimum of 15 dBm above the signal booster gain under all operating conditions. (NFPA 72-24.5.2.3.3)
Note: NFPA 1221 (2016) requires a minimum of 20 dBm. Any lower value may result in the probability of failing the final inspection.

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2A.1.1 NFPA 72 (2013) Plan Review - Fire (cont.)

- 19. System radio frequencies; system shall be capable of transmitting all public safety radio frequencies assigned to the FCC AHJ (License Holder) and be capable of using any modulation technology. (NFPA 72-24.5.2.4)
- 20. Frequency changes. System shall be capable of upgrading. (NFPA 72-24.5.2.4.2)
- 21. System Components: Components shall be approved and compatible with the local Public Safety Radio System. (NFPA 72-24.5.2.5.1) (NFPA-1.1.4)
- 22. All repeaters, transmitter receptacles, signal booster components and battery system components shall be in a NEMA 4, 4X enclosure. (NFPA 72-24.5.2.5.2) (NFPA 1-1.4)
- 23. Power supplies shall have at least two independent sources. (NFPA 72-24.5.5)
- 24. The primary power source shall be supplied from a dedicated circuit and shall comply with NFPA 72-10.6.5. (NFPA 72-24.5.5.1)
- 25. The secondary power source shall consist of one of the following (NFPA 72-24.5.2.5.5.2):
 - (1) Battery with at least 12 hours of operation at 100% per NFPA 72-24.5.2.5.5.2.1
 - (2) Battery with at least 24 hours of operation at 100% per NFPA 72-10.6.7.2.1
Legally required generator with at least 12 hours of operation at 100%
- 26. System Monitoring: The fire alarm system shall monitor the following items as a minimum (NFPA 72-24.5.2.6.1):
 - (1) Integrity of the circuit monitoring signal booster(s) and power supply(ies) shall comply with NFPA 72-24.10.6.9 and NFPA 72-12.6.
 - (2) System and signal booster supervisory signals shall include the following:
 - (a) Antenna malfunction
 - (b) Signal booster failure
 - (c) Low-battery capacity indication when 70 percent of the 12-hour operating capacity has been depleted.
 - (3) Power supply signals shall include the following for each signal booster:
 - (a) Loss of normal AC power
 - (b) Failure of battery charger
- 27. Dedicated Panel (annunciator panel) shall show (NFPA 72-24.5.2.6.2):
 - (1) Normal AC power
 - (2) Signal booster trouble
 - (3) Loss of normal AC power
 - (4) Failure of battery charger
 - (5) Low battery capacity
- 28. Technical Criteria (NFPA 72-24.5.2.7)
 - (1) Frequencies required
 - (2) Location and effective radiated power (ERP) of the FCC AHJ radio site
 - (3) Maximum propagation delay less than 30 micro-seconds
 - (4) List of specifically approved system components
 - (5) Other support technical information (Battery calculations)(NFPA 72-10.6.7.2.1)
- 29. When an elevator(s) is(are) present in the building, an antenna is typically required to be mounted in the elevator shaft(s) to get coverage inside the elevator car(s). A note on the plan shall be provided: "Contractor shall obtain written approval from the elevator inspector prior to any work inside an elevator shaft or machine room." (NFPA 72-24.5.4) (ASME A17.1)

Note: This checklist is a minimum checklist. Coordinate with the local Fire AHJ for additional checklist items.

2A.1.2 NFPA 72 (2013) Plan Review - Electrical

Plans shall include the following information:

- 1. Building owner and address
- 2. Copy of the contract with the owner or GC (FAC 61G15)
- 3. Signature and seal of the Engineer of Record with experience and training in electrical engineering. The name, PE number, business name, CA number, address, and contact information shall be shown on the plans. (FBC BC 118.1.4) (61G15-30.003(2))
- 4. Applicable codes and edition dates (61G15-30.003(1b))
- 5. Building description showing building construction, building occupancy, total square footage, number of floors, total height of building (FAC 61G15)
- 6. Floor plans showing device locations, fire-rated enclosures, conduit runs, etc. (FBC BC 118.2.1.4)
- 7. Riser plans for systems (FAC 61G15-33)
- 8. Specifications with manufacturer's parts numbers (FAC 61G15)
- 9. Details, including firewall penetration, etc. (FAC 61G15) (NFPA 70-820-26)
- 10. Grounding and mounting details for antenna, mast, surge protection, BDA, power supply, battery enclosure, etc. (FAC 61G15)(NFPA 70)
- 11. Antenna NFPA 780 protection (if existing). (FAC 61G15) (NFPA 780)
- 12. The BDA enclosure shall be painted red and a sign shall show permit number, vendor name, and telephone number. (FBC BC 118.2.1.8)
- 13. Show how the system components are wired to power (120V). (NFPA 70-110.2(B))
- 14. Circuit shall have an isolated ground, if required by the manufacturer. (NFPA 70)
- 15. Listing and labeling requirements (NFPA 70-110.2)
- 16. Identify minimum conduit sizes and minimum conduit 90-degree bend radiuses. (NFPA 70-110.3)
- 17. System equipment shall be installed in an air-conditioned and mechanically ventilated room where the manufacturer's installation document requires a temperature limitation and/or ventilation. (NFPA 70-110.3)

Note: This checklist is a minimum checklist. Coordinate with the local Electrical AHJ for additional checklist items.

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2A.1.3 NFPA 72 (2013) Plan Review - Elevator

Plans shall include the following information:

A variance shall be obtained from the Broward County Elevator Inspection Services Section at Permitting prior to any work inside an elevator shaft or elevator machine room. The variance shall be to install one or more antenna(s) in the elevator shaft(s). (ASME A17.1)

Note: The elevator code does not allow the elevator shaft to be used for coaxial cable risers.
(ASME A17.1.2.8.1)

Note: This checklist is a minimum checklist. Coordinate with the local Elevator AHJ for additional checklist items.

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2A.1.4 NFPA 72 (2013) Plan Review – Building (Structural)

- 1. Structural design calculations for antenna mast (if applicable, FBC BC 107.3.5)
- 2. Attachment and roof penetration details on plan for antenna mast (if applicable, FBC BC 107.3.5)
- 3. Floor plans showing fire-rated enclosures for cables and BDA room, including fire-rated UL designs (if applicable, FBC BC 107.3.5)
- 4. Riser plans showing fire-rated enclosure for cable, including fire-rated UL designs (if applicable, FBC BC 107.3.5)
- 5. Firewall penetrations, including UL designs (if applicable, FBC BC 107.3.5)

Note: This checklist is a minimum checklist. Coordinate with the local AHJ for additional checklist items.

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2A.1.5 NFPA 72 (2013) Plan Review – FCC AHJ (License Holder)

Plans shall include the following information:

- 1. Building owner and address
- 2. Building description showing building construction, building occupancy, total square footage, number of floors, total height of building
- 3. Applicable codes and edition dates
- 4. Floor plans showing device locations, fire-rated enclosures, conduit runs, and propagation modeling, etc. Propagation (heat) map drawings shall include the following (FBC BC 118.2.1.4):
 - Indoor Prediction Legend
 - Pictogram Legend
 - Calculations Legend
 - Number of Channels
 - Predictive propagation shown on floor plans
 - Name of certified designer and company
 - Materials Legend
 - Cables Legend
 - Frequencies or frequency bands for the Public Radio System(s)
- 5. Riser plans for systems
- 6. Specifications with manufacturer's parts numbers
- 7. Manufacturer's specifications for equipment; include equipment temperature limits.
- 8. Grounding and mounting details for antenna, mast, surge protector, BDA, power supply, battery enclosure. (IEEE 1692, TIA 569, TIA 607)
- 9. Notes on plans shall state:

"The system shall never be energized for testing or operation until written, or on site, approval is obtained from all applicable FCC License Holders."
- 10. The BDA enclosure shall be painted red and a sign shall show permit number, vendor name and telephone number.
- 11. Signal strength inbound shall be a minimum of -95 dBm. Signal strength outbound shall be a minimum of -95 dBm.

Note: a signal strength of less than -90 dBm shown on the plans has a high probability of failing the final inspection of -95 dBm minimum.
- 12. Isolation shall be a minimum of 15 dBm above the (maximum) signal booster gain under all operating conditions.
- 13. System radio frequencies: system shall be capable of transmitting (transporting) all public safety radio frequencies used by the FCC AHJ (License Holder) and be capable of using any modulation technology.
- 14. Frequency changes. System shall be capable of upgrading.
- 15. System Components: Components shall be approved and compatible with the Public Safety Radio System. Show the propagation delay. Signal Boosters shall have FCC Certification. Power supplies shall have at least two independent supplies. Battery shall provide twelve (12) hour minimum operational run time. (Provide a battery calculation at 100%)
- 16. Technical Criteria
 - (1) Frequencies or frequency bands required
 - (2) Location and effective radiated power (ERP) of the FCC AHJ radio site
 - (3) Maximum propagation delay (30 microseconds)
 - (4) List of specifically approved system components
 - (5) Other supporting technical information

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2A.1.5 NFPA 72 (2013) Plan Review - FCC AHJ (License Holder) (cont.)

- 17. When an elevator(s) is(are) present in the building, an antenna is typically required to be mounted in the elevator shaft(s) to get coverage inside the elevator car(s). A note on the plan shall be provided: “Contractor shall obtain written approval from the elevator inspector prior to any work inside an elevator shaft or machine room.
- 18. Other industry standards include IEEE 1692, TIA 569, and TIA 607.

Note: This checklist is a minimum checklist. Coordinate with the local FCC AHJ (License Holder) for additional checklist items.

See Part 3. Additional Information attachments:

3.2 FCC AHJ (License Holder) Additional Requirements

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2A.2.1 NFPA 72 (2013) Inspection - Fire

Final Inspection

Property Information

Property Name: _____ Permit #: _____ Inspection Date: _____

Property Address: _____

Contact Information:

BDA Equipment Provider: _____

BDA Licensed Contractor: _____

Fire Alarm Licensed Contractor: _____

Fire Alarm Monitoring Company: _____

Engineer of Record: _____

- 1. The latest approved record drawings, operation manuals, and maintenance manuals are on the site.
- 2. The following representatives are on the site for the inspection:
 - Fire Inspector
 - Broward County RESL (ORCAT)
 - Ft. Lauderdale TeleCom
 - Electrical Inspector
 - BDA equipment provider (systems integrator)
 - BDA Licensed Contractor
 - Fire Alarm Licensed Contractor
 - Engineer of Record, only for re-inspections
 - Building Owner Representative
- 3. Fire Rated Enclosure openings and penetrations are properly sealed. (NFPA 1-12.7.5.1)
- 4. The installation complies with the pathway of survivability level as shown on the approved record drawings.
- 5. The system components match the approved record drawings for manufacturer and part numbers. (NFPA 72-24.5.2.5.1) (NFPA-1.1.4)
- 6. The BDA enclosure shall be painted red and a sign shall show permit number, vendor name and telephone number. (FBC BC 118.2.1.8)
- 7. Provide an information binder stored next to the BDA. Information shall include (NFPA 72-14.6.1.1) (FBC BC 118):
 - (1) As-built drawings
 - (2) Manufacturer's data sheets and specs
 - (3) Heat map, final measured readings after commissioning
 - (4) Final signal strength measurement (dB)
 - (5) Maintenance contract
 - (6) Broward County RESC, FCC AHJ (License Holders), all other approvals, and elevator variance letter, if applicable.
 - (7) Maintenance Repair Log
- 8. Pathway survivability level shall be 1, 2, or 3. For Level 1, all coaxial cables shall be in metal raceways. (NFPA 72-12.4)
- 9. The feeder and riser coaxial cables shall be rated as plenum cables. (NFPA 72-24.3.6.8.1.1)
- 10. Riser coaxial cables shall be routed through a 2-hour-rated enclosure. (NFPA 72-24.3.6.8.3)

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2A.2.1 NFPA 72 (2013) Inspection - Fire (cont.)

- 11. Radio coverage shall be a minimum of 99% in critical areas, such as the fire command center(s), the fire pump room(s), exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the AHJ and 90% in general building areas. (NFPA 72-24.5.2.2)
- 12. Signal strength inbound shall be a minimum of -95 dBm. (NFPA 72-24.5.2.3.1)
Signal strength outbound shall be a minimum of -95 dBm. (NFPA 72-24.5.2.3.2)
- 13. Isolation shall be a minimum of 15 dBm above the signal booster gain under all operating conditions. (NFPA 72-24.5.2.3.3)
- 14. System radio frequencies; system shall be capable of transmitting all public safety radio frequencies assigned to the FCC AHJ (License Holder). (NFPA 72-24.5.2.4)
- 15. Frequency changes. System shall be capable of upgrading. (NFPA 72-24.5.2.4.2)
- 16. System Components: Components shall be approved and compatible with the Public Safety Radio System. (NFPA 72-24.5.2.5.1) (NFPA-1.1.4)
- 17. All repeaters, transmitter receptacles, signal booster components and battery system components shall be in a NEMA 4, 4X enclosure. (NFPA 72-24.5.2.5.2) (NFPA 1-1.4)
- 18. Power supplies shall have at least two independent sources. (NFPA 72-24.5.5)
- 19. The primary power source shall be supplied from a dedicated circuit and shall comply with NFPA 72-10.6.5. (NFPA 72-24.5.5.1)
- 20. The secondary power source shall consist of one of the following (NFPA 72-24.5.5.2):
 - (1) Battery with at least 12 hours of operation at 100% per NFPA 72-24.5.2.5.5.2.1
 - (2) Battery with at least 24 hours of operation at 100% per NFPA 72-10.6.7.2.1
Legally required generator with at least 12 hours of operation at 100%
- 21. System Monitoring: The fire alarm system shall monitor the following items as a minimum (NFPA 72-24.5.2.6.1):
 - (1) Integrity of the circuit monitoring signal booster(s) and power supply(ies) shall comply with NFPA 72-24.10.6.9 and NFPA 72-12.6 (Auto-notification within 3 minutes 20 seconds).
 - (2) System and signal booster supervisory signals shall include the following:
 - (a) Antenna malfunction
 - (b) Signal booster failure
 - (c) Low-battery capacity indication when 70 percent of the 12-hour operating capacity has been depleted.
 - (3) Power supply signals shall include the following for each signal booster:
 - (a) Loss of normal AC power
 - (b) Failure of battery charge
- 22. Dedicated Panel (annunciator panel) shall show (Auto-notification within 3 minutes, 20 seconds) (NFPA 72-24.5.2.6.2):
 - (1) Normal AC power
 - (2) Signal booster trouble
 - (3) Loss of normal AC power
 - (4) Failure of battery charger
 - (5) Low battery capacity

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2A.2.1 NFPA 72 (2013) Inspection - Fire (cont.)

- 23. Signage is provided to locate the BDA.
Fire Department signal booster permit number, service provider, and contact telephone numbers are shown. (NFPA 72-10.18.3.2)
- 24. Completed NFPA documentation specific to this system is provided. [NFPA 72-7.8.2; figure 7.8.2(a) and (b)]
- 25. Documentation is provided showing that a maintenance and service agreement has been entered into between the property owner and the provider of the BDA System.
(NFPA 72-14.4.10.1) (NFPA 72-14.4.10.6) (NFPA 72-14.6.1.1)
- 26. DAQ, Delivered Audio Quality, for the system is a minimum of DAQ 3.0. Include all floors, critical areas, elevator cabs, and general building areas.

Note: This checklist is a minimum checklist. Coordinate with the local Fire AHJ for additional checklist items.

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2A.2.2 NFPA 72 (2013) Inspection - Electrical

- 1. **Rough Electrical Inspection** (FBC BC (2017)-1.110.8.5)
 - Installation of conduits
 - Installation of coaxial cables
 - Panels, BDA, and BBU shall be grounded.
 - Antenna and mast
 - Grounding, Lightning Protection System (if installed)
 - Lead-in surge protection
 - Power connection to the BDA
 - Installation of conduits and equipment in fire-rated enclosures or rooms

- 2. **Final Inspection**
 - All electrical components are in place.
 - Label "BDA" circuit breakers.

Note: This checklist is a minimum checklist. Coordinate with the local Electrical AHJ for additional checklist items.

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2A.2.3 NFPA 72 (2013) Inspection - Elevator

1. Rough System Inspection

- Conduit and cable installed in elevator shafts.

2. Final Inspection

- Antenna(s) installed in the elevator shaft.

Note: This checklist is a minimum checklist. Coordinate with the local Elevator AHJ for additional checklist items.

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2A.2.4 NFPA 72 (2013) Inspection – Building (Structural)

Rough Inspections:

Structural

- 1. Inspection for all fire-rated enclosures/penetrations for cables and BDA room (FBC BC 110.3)
 - a. Framing inspection, if applicable
 - b. Drywall inspection, if applicable
- 2. In progress roof penetrations (if applicable, FBC BC 110.3)

Final Inspections:

Structural

- 1. Antenna mast installation (FBC BC 110.3)
- 2. Inspection for all fire-rated enclosures/penetrations for cables and BDA room (FBC BC 110.3)
- 3. Roof final (if applicable, FBC BC 110.3)

Note: This checklist is a minimum checklist. Coordinate with the local AHJ for additional checklist items.

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2A.2.5 NFPA 72 (2013) Inspection - FCC AHJ (License Holder)

1. Initial Inspection

- 1. The system shall never be energized for testing or operation until written, or onsite approval is obtained from the FCC License Holders.
- 2. Prior to the initial inspection, a letter from the Engineer of Record stating that the installation is complete and ready to be energized for testing shall be received by the FCC License Holders. The system settings and pictures of the installed major components shall also be provided to the FCC License Holders.

The following equipment and components shall be included in the letter and pictures:

- (1) BDA with information
Permit Number; Serviced by _____; Telephone _____
 - (2) Enclosures with battery charger and batteries installed, wired with a label showing the battery installation date.
 - (3) The Dedicated annunciator shall be wired. The system shall be constructed and programmed to the FACP and the annunciator.
 - (4) All equipment shall be properly grounded per TIA 607.
 - (5) Antenna mast shall be grounded.
 - (6) Antenna shall have surge protection installed and wired.
 - (7) Antenna(s), if installed in the elevator shaft, shall have the approval of the Elevator Inspector. Provide a copy of the variance.
 - (8) Junction boxes connected to the riser coaxial cables to the horizontal cables shall be installed and wired.
 - (9) All electrical rough inspections shall be completed.
- 3. The contractor shall coordinate the inspection with all responsible parties.
The following shall be present at a minimum:
 - Owners representative
 - Electrical Contractor
 - Fire Alarm Contractor
 - BDA Vendor representative with analyzer and computer to gain access to the BDA program to check levels and settings.
 - FCC AHJ(s) (License Holders)(There may be more than one).
 - 4. The Initial Inspection shall include the following:
 - (1) The System shall be energized for the first time.
 - (2) Items (1) through (10) in Section 2 above shall be inspected for compliance.
 - (3) Acceptable dB levels shall be spot checked. Include stairwells and elevator cab.
 - (4) Check the noise floor of the BDA transmitter. The noise floor shall be -100 dB to -105 dB or less than a 5 dB increase in the noise floor.
 - (5) System Engineer of Record shall attend all inspections, if required by the AHJ.

Note: This checklist is a minimum checklist. Coordinate with the local FCC AHJ (License Holder) for additional checklist items.

See Part 3. Additional Information attachments:

3.2 FCC AHJ (License Holder) Additional Requirements

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2A.2.5 NFPA 72 (2013) Inspection - FCC AHJ (License Holder) (cont.)

Final Inspection

This Inspection is a joint effort between the Fire Official and the FCC AHJ (License Holders). Prior to the final inspection, the contractor shall provide to the Fire Official and to the FCC AHJ (License Holders) the following documentation showing that the building is ready for the final inspection.

After passing the initial inspection, the contractor shall submit to the FCC AHJ (License Holder) a Post Heat Map Study, with the actual measured signal strengths, to show that all areas are covered per the code. A letter from the Engineer of Record shall state that the System is completed, fully operational, and ready for the final inspection.

The contractor shall coordinate the inspection with all responsible parties. The following shall be present at a minimum:

- Owners representative
- Electrical Contractor
- Fire Alarm Contractor
- BDA Vendor representative with analyzer and computer to gain access to the BDA program to check levels and settings.
- System Engineer of Record, if required by the AHJ.
- Electrical AHJ
- Fire Official AHJ
- FCC AHJ(s) (License Holder(s))(City and County) (There may be more than one.)

Final Inspection:

- (1) Building Radio Coverage Inspection
 - 99% in critical areas
 - 90% in general building
 - DAQ 3.0 or better
- (2) All dB levels are acceptable

Note: This checklist is a minimum checklist. Coordinate with the local FCC License Holder AHJ for additional checklist items.

See Part 3. Additional Information attachments:

3.2 FCC AHJ (License Holder) Additional Requirements

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Broward County Board of Rules and Appeals
Two-Way Radio Communications Enhancement Systems
BORA RCES Guidelines

Part 2B. Recommended Checklists for NFPA 72 (2016), NFPA 1221 (2016)

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2B.1.1 NFPA 72 (2016), NFPA 1221 (2016) Plan Review - Fire

Plans shall include the following information:

- 1. Building owner and address
- 2. Written sequence of operation
- 3. Signature and seal of the Engineer of Record with experience and training in electrical engineering. The name, PE number, business name, CA number, address, and contact information shall be shown on the plans. The AHJ may require that the Engineer of Record provide evidence of experience and training in Electrical Engineering. (NFPA 72-10.5)
- 4. Applicable codes and edition dates
- 5. Building description showing building construction, building occupancy, total square footage, number of floors, total height of building (NFPA 1-1.7.12) (NFPA 72-7.4)
- 6. Floor plans showing device locations, fire-rated enclosures, conduit runs, and propagation modeling, etc. (NFPA 1) (NFPA 1-1.7.12) (NFPA 72-7.4)
- 7. Riser plans for systems (NFPA 1-1.7.12) (NFPA 72-7.4)
- 8. Specifications with manufacturer's parts numbers (NFPA 1-1.7.12) (NFPA 72-7.4)
- 9. Firewall penetration details, etc. (NFPA 1-12.7.5.1, NFPA 1-1.7.12) (NFPA 72-7.4)
- 10. Identify the panel and circuit breaker; show panel location on plan. (NFPA 1-1.7.12) (NFPA 72-7.4)
- 11. Show circuit breaker lock. (NFPA 1-1.7.12) (NFPA 72-10.6.5.4)
- 12. Provide an information binder stored next to the BDA. Information shall include (NFPA 72-7.5):
 - (1) As-built drawings
 - (2) Manufacturer's data sheets and specs
 - (3) Heat maps with the final signal strength readings
 - (4) Final signal strength measurements (dB)
 - (5) Maintenance contract
 - (6) Broward County RESC, FCC AHJ (License Holder), all other approvals, and elevator variance letter, if applicable.
 - (7) Maintenance Repair Log
- 13. Pathway survivability level shall be 1, 2, or 3. For Level 1, all coaxial cables shall be in metal raceways. (NFPA 1221-5.10)
- 14. The feeder and riser coaxial cables shall be rated as plenum cable. (NFPA 1221-9.6.2.1.1)
- 15. Riser coaxial cables shall be routed through a 2-hour-rated enclosure. (Performance alternatives, as shown on the drawings, shall be approved by the AHJ.) (NFPA 1221-9.6.2.1.3)
- 16. Radio coverage shall be a minimum of 99% in critical areas, such as the fire command center(s), the fire pump room(s), exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the AHJ and 90% in general building areas. (NFPA 1221-9.6.7)
- 17. Signal strength inbound shall be a minimum of DAQ 3.0. (NFPA 1221-9.6.8.1)
Signal strength outbound shall be a minimum of DAQ 3.0. (NFPA 1221-9.6.8.2)
- 18. Donor antenna isolation shall be a minimum of 20 dBm above the inside antennas. (NFPA 1221-9.6.9)
- 19. System radio frequencies; system shall be capable of transmitting all public safety radio frequencies assigned to the FCC AHJ and be capable of using any modulation technology. (NFPA 1221-9.6.10.1)
- 20. Frequency changes. System shall be capable of upgrading. (NFPA 1221-9.6.10.2)

2B.1.1 NFPA 72 (2016), NFPA 1221 (2016) Plan Review - Fire (cont.)

- 21. System Components: Components shall be approved and compatible with the Public Safety Radio System. (NFPA 1221-9.6.11) (NFPA-1.1.4)
- 22. All repeaters, transmitter receptacles, signal booster components and battery system components shall be in a NEMA 4, 4X enclosure. (NFPA 1221-9.6.11.2) (NFPA 1-1.4)
- 23. Power supplies shall have at least two independent sources. (NFPA 1221-9.6.12)
- 24. The primary power source shall be supplied from a dedicated circuit and shall comply with NFPA 72. (NFPA 1221-9.6.12.1)
- 25. The secondary power source shall consist of one of the following (NFPA 1221-9.6.12.2):
 - (1) Battery with at least 12 hours of operation at 100%
 - (2) Battery with at least 24 hours of operation at 100%
Legally required generator with at least 12 hours of operation at 100%
- 26. System Monitoring: The fire alarm system shall monitor the following items as a minimum (NFPA 1221-9.6.13.1):
 - (1) Monitoring for integrity of the system shall comply with NFPA 72-10
 - (2a) Donor antenna malfunction
 - (2b) Active RF emitting device failure (70%)
 - (2c) Low battery capacity indicator
 - (2d) System component failure
 - (3a) Loss of normal AC power
 - (3b) Failure of battery charger
 - (4) Communication link between the Dedicated Monitoring Panel and the BDA shall be monitored for integrity.
- 27. Dedicated Panel (annunciator panel) shall show (NFPA 1221-9.6.13.2):
 - (1a) Normal AC power
 - (1b) Loss of normal power
 - (1c) Battery charger failure
 - (1d) Low battery capacity
 - (1e) Donor antenna malfunction
 - (1f) Active RF emitting device malfunction
 - (1g) System component malfunction
 - (2) Communication link between the Dedicated Monitoring Panel and the BDA shall be monitored for integrity.
- 28. Technical Criteria (NFPA 1221-9.6.14)
 - (1) Frequencies required
 - (2) Location and effective radiated power (ERP) of the FCC AHJ radio site
 - (3) Maximum propagation delay less than 30 micro-seconds
 - (4) List of specifically approved system components
 - (5) Other support technical information (Battery calculations)(NFPA 72-10.6.7.2.1)
- 29. When an elevator(s) is(are) present in the building, an antenna is typically required to be mounted in the elevator shaft(s) to get coverage inside the elevator car(s). A note on the plan shall be provided: "Contractor shall obtain written approval from the elevator inspector prior to any work inside an elevator shaft or machine room. (ASME A17.1)
- 30. Systems shall have a Lightning Protection System that complies with NFPA 780. (NFPA 1221-9.6.3)

Note: This checklist is a minimum checklist. Coordinate with the local Fire AHJ for additional checklist items.

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2B.1.2 NFPA 72 (2016), NFPA 1221 (2016) Plan Review - Electrical

Plans shall include the following information:

- 1. Building owner and address
- 2. Copy of the contract with the owner or GC (FAC 61G6)
- 3. Signature and seal of the Engineer of Record with experience and training in electrical engineering. The name, PE number, business name, CA number, address, and contact information shall be shown on the plans. (FBC BC 118.1.4) (61G15-30.003(2))
- 4. Applicable codes and edition dates (61G15-30.003(1b))
- 5. Building description showing building construction, building occupancy, total square footage, number of floors, total height of building (FAC 61G15)
- 6. Floor plans showing device locations, fire-rated enclosures, conduit runs, and propagation modeling, etc. (FBC BC 118.2.1.4)
- 7. Riser plans for systems (FAC 61G15)
- 8. Specifications with manufacturer's parts numbers (FAC 61G15-~~33~~)
- 9. Details, including firewall penetration, etc. (FAC 61G15) (NFPA 70 820-26)
- 10. Grounding and mounting details for antenna, mast, surge protection, BDA, power supply, battery enclosure, etc. (FAC 61G15) (NFPA 70)
- 11. Antenna NFPA 780 protection, if existing. If not existing, add system. (FAC 61G15) (NFPA 780)
- 12. The BDA enclosure shall be painted red and a sign shall show permit number, vendor name, and telephone number. (FBC BC 118.2.1.8)
- 13. Show how the system components are wired to power (120V). (NFPA 70-110.2(B))
- 14. Circuit shall have an isolated ground, if required by the manufacturer. (NFPA 70)
- 15. Listing and labeling requirements (NFPA 70-110.2)
- 16. Identify minimum conduit sizes and minimum conduit 90-degree bend radiuses. (NFPA 70-110.3)
- 17. System equipment shall be installed in an air-conditioned and mechanically ventilated room where the manufacturer's installation document requires a temperature limitation and/or ventilation. (NFPA 70-110.3)

Note: This checklist is a minimum checklist. Coordinate with the local Electrical AHJ for additional checklist items.

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2B.1.3 NFPA 72 (2016), NFPA 1221 (2016) Plan Review - Elevator

Plans shall include the following information:

A variance shall be obtained from the Broward County Elevator Inspection Services Section at Permitting prior to any work inside an elevator shaft or elevator machine room. The variance shall be to install an antenna in the elevator shaft(s) (ASME A17.1).

Note: The elevator code does not allow the elevator shaft to be used for coaxial cable risers.
(ASME A17.1.2.8.1)

Note: This checklist is a minimum checklist. Coordinate with the local Elevator AHJ for additional checklist items.

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2B.1.4 NFPA 72 (2016), NFPA 1221 (2016) Plan Review – Building (Structural)

- 1. Structural design calculations for antenna mast (if applicable, FBC BC 107.3.5)
- 2. Attachment and roof penetration details on plan for antenna mast (if applicable, FBC BC 107.3.5)
- 3. Floor plans showing fire-rated enclosures for cables and BDA room, including fire-rated UL designs (if applicable, FBC BC 107.3.5)
- 4. Riser plans showing fire-rated enclosure for cable, including fire-rated UL designs (if applicable, FBC BC 107.3.5)
- 5. Firewall penetrations, including UL designs (if applicable, FBC BC 107.3.5)

Note: This checklist is a minimum checklist. Coordinate with the local AHJ for additional checklist items.

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2B.1.5 NFPA 72 (2016), NFPA 1221 (2016) Plan Review – FCC AHJ (License Holder)

Plans shall include the following information:

- 1. Building owner and address
- 2. Building description showing building construction, building occupancy, total square footage, number of floors, total height of building
- 3. Applicable codes and edition dates
- 4. Floor plans showing device locations, fire-rated enclosures, conduit runs, and propagation modeling, etc. Propagation (heat) map drawings shall include the following (FBC BC 118.2.1.4):
 - Indoor Prediction Legend
 - Pictogram Legend
 - Calculations Legend
 - Number of Channels
 - Predictive propagation shown on floor plans
 - Name of certified designer and company
 - Materials Legend
 - Cables Legend
 - Frequencies or frequency bands for the Public Radio System(s)
- 5. Riser plans for systems
- 6. Specifications with manufacturer's parts numbers
- 7. Manufacturer's specifications for equipment; include equipment temperature limits.
- 8. Grounding and mounting details for antenna, mast, surge protector, BDA, power supply, battery enclosure. (IEEE 1692, TIA 569, TIA 607)
- 9. Notes on plans shall state:

"The system shall never be energized for testing or operation until written, or on site, approval is obtained from all applicable FCC License Holders."
- 10. The BDA enclosure shall be painted red and a sign shall show permit number, vendor name and telephone number.
- 11. Signal strength inbound shall be a minimum of -95 dBm. Signal strength outbound shall be a minimum of -95 dBm.
- 12. Isolation shall be a minimum of 15 dBm above the (maximum) signal booster gain under all operating conditions.
- 13. System radio frequencies: system shall be capable of transmitting (transporting) all public safety radio frequencies used by the FCC AHJ (License Holder) and be capable of using any modulation technology.
- 14. Frequency changes. System shall be capable of upgrading.
- 15. System Components: Components shall be approved and compatible with the Public Safety Radio System. Show the propagation delay. Signal Boosters shall have FCC Certification. Power supplies shall have at least two independent supplies. Battery shall provide twelve (12) hour minimum operational run time. (Provide a battery calculation at 100%)
- 16. Technical Criteria
 - (1) Frequencies or frequency bands required
 - (2) Location and effective radiated power (ERP) of the FCC AHJ radio site
 - (3) Maximum propagation delay (30 microseconds)
 - (4) List of specifically approved system components
 - (5) Other supporting technical information

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2B.1.5 NFPA 72 (2016), NFPA 1221 (2016) Plan Review - FCC AHJ (License Holder) (cont.)

- 17. When an elevator(s) is(are) present in the building, an antenna is typically required to be mounted in the elevator shaft(s) to get coverage inside the elevator car(s). A note on the plan shall be provided: “Contractor shall obtain written approval from the elevator inspector prior to any work inside an elevator shaft or machine room.
- 18. Other industry standards include IEEE 1692, TIA 569, and TIA 607.

Note: This checklist is a minimum checklist. Coordinate with the local FCC AHJ (License Holder) for additional checklist items.

See Part 3. Additional Information attachments:

3.2 FCC AHJ (License Holder) Additional Requirements

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2B.2.1 NFPA 72 (2016), NFPA 1221 (2016) Inspection - Fire

Final Inspection

Property Information

Property Name: _____ Permit #: _____ Inspection Date: _____

Property Address: _____

Contact Information:

BDA Equipment Provider: _____

BDA Licensed Contractor: _____

Fire Alarm Licensed Contractor: _____

Fire Alarm Monitoring Company: _____

Engineer of Record: _____

- 1. The latest approved record drawings, operation manuals, and maintenance manuals are on the site.
- 2. The following representatives are on the site for the inspection:
 - Fire Inspector
 - Broward County RESL(ORCAT)
 - Ft. Lauderdale TeleCom
 - Electrical Inspector
 - BDA equipment provider (systems integrator)
 - BDA Licensed Contractor
 - Fire Alarm Licensed Contractor
 - Engineer of Record, only for re-inspections, if required by the AHJ
 - Building Owner Representative
- 3. Fire Rated Enclosure openings and penetrations are properly sealed. (NFPA-1-12.7.5.1)
- 4. The installation complies with the pathway of survivability as shown on the approved record drawings.
Note: A level 1 pathway requires coaxial cables installed in metal raceways. (NFPA 1221-5.10)
- 5. The system components match the approved record drawings for manufacturer and part numbers.
(NFPA 1221-9.6.11.1) (NFPA-1.1.4)
- 6. The BDA enclosure shall be painted red and a sign shall show permit number, vendor name and telephone number. (FBC BC 118.2.1.8)
- 7. Provide an information binder stored next to the BDA. Information shall include:
(NFPA 72-14.6.1.1) (FBC BC 118)
 - (1) As-built drawings
 - (2) Manufacturer's data sheets and specs
 - (3) Heat map
 - (4) Final signal strength measurement (dB)
 - (5) Maintenance contract
 - (6) Broward County RESC, FCC AHJ (License Holders), all other approvals and elevator variance letter, if applicable.
 - (7) Maintenance Repair Log
- 8. Pathway survivability level shall be 1, 2, or 3. For Level 1, all coaxial cables shall be in metal raceways.
(NFPA 1221-5.10)
- 9. The feeder and riser coaxial cables shall be rated as plenum cables. (NFPA 1221-9.6.2.1.1.1)
- 10. Riser coaxial cables shall be through an enclosure matching the building's fire rating.
(NFPA 1221-9.6.2.1.3)

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2B.2.1 NFPA 72 (2016), NFPA 1221 (2016) Inspection - Fire (cont.)

- 11. Radio coverage shall be a minimum of 99% in critical areas, such as the fire command center(s), the fire pump room(s), exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the AHJ and 95% in general building areas. (NFPA 1221-9.3.1.2.1)
- 12. Signal strength inbound shall be a minimum of DAQ 3.0. (NFPA 1221-9.6.8.1)
Signal strength outbound shall be a minimum of DAQ 3.0. (NFPA 1221-9.6.8.2)
- 13. Isolation shall be a minimum of 20 dBm above the signal booster gain under all operating conditions. (NFPA 1221-9.6.9)
- 14. System radio frequencies: system shall be capable of transmitting all public safety radio frequencies assigned to the FCC AHJ (License Holder). (NFPA 1221-9.6.10.1)
- 15. Frequency changes: System shall be capable of upgrading. (NFPA 1221-9.6.10.2)
- 16. System Components: Components shall be approved and compatible with the Public Safety Radio System. (NFPA 1221-9.6.11)
- 17. All repeaters, transmitter receptacles, signal booster components and battery system components shall be in a NEMA 4, 4X enclosure. (NFPA 1221-9.6.11.2) (NFPA 1-1.4)
- 18. Power supplies shall have at least two independent sources. (NFPA 1221-9.6.12)
- 19. The primary power source shall be supplied from a dedicated circuit and shall comply with NFPA 72. (NFPA 1221-9.6.12.1)
- 20. The secondary power source shall consist of one of the following (NFPA 1221-9.6.12.2):
 - (1) Battery with at least 12 hours of operation at 100%
 - (2) Battery with at least 24 hours of operation at 100%
Legally required generator with at least 12 hours of operation at 100%
- 21. System Monitoring: The fire alarm system shall monitor the following items as a minimum (NFPA 1221-9.6.13.1):
 - (1) Monitoring for integrity of the system shall comply with NFPA 72-10
 - (2a) Donor antenna malfunction
 - (2b) Active RF emitting device failure
 - (2c) Low battery capacity indicator
 - (2d) System component failure
 - (3a) Loss of normal AC power
 - (3b) Failure of battery charger
 - (4) Communication link between the FACP and the BDA shall be monitored for integrity.
- 22. Dedicated Panel (annunciator panel) shall show (Auto-notification within 3 minutes, 20 seconds) (NFPA 1221-9.6.13.2):
 - (1a) Normal AC power
 - (1b) Loss of normal power
 - (1c) Battery charger failure
 - (1d) Low battery capacity
 - (1e) Donor antenna malfunction
 - (1f) Active RF emitting device malfunction
 - (1g) System component malfunction
 - (2) Communication link between the FACP and the BDA shall be monitored for integrity.

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2B.2.1 NFPA 72 (2016), NFPA 1221 (2016) Inspection - Fire (cont.)

- 23. Signage is provided to locate the BDA.
Fire Department signal booster permit number, service provider, and contact telephone numbers are shown. (FBC 118.2.1.8) (NFPA 72-10.18.3.2)
- 24. Completed NFPA documentation specific to this system is provided. [NFPA 72-7.8.2; figure 7.8.2(a) and (b)]
- 25. Documentation is provided showing that a maintenance and service agreement has been entered into between the property owner and the provider of the BDA System.
(NFPA 72-14.4.10.1) (NFPA 72-14.4.10.6) (NFPA 72-14.6.1.1)
- 26. DAQ, Delivered Audio Quality, for the system is a minimum of DAQ 3.0. Include all floors, critical areas, elevator cabs, and general building areas. (NFPA 1221-9.6.7.3)
- 27. Where required by the manufacturer, the power receptacle shall be an isolated ground type receptacle and shall be connected to an isolated ground. (NFPA 1221-5.8.2)
- 28. Systems shall have a Lightning Protection System that complies with NFPA 780. (NFPA 1221-9.6.3)

Note: This checklist is a minimum checklist. Coordinate with the local Fire AHJ for additional checklist items.

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2B.2.2 NFPA 72 (2016), NFPA 1221 (2016) Inspection - Electrical

- 1. **Rough Electrical Inspection** (FBC BC (2017)-1.110.8.5)
 - Installation of conduits
 - Installation of coaxial cables
 - Panels, BDA, and BBU shall be grounded.
 - Antenna and mast
 - Grounding, Lightning Protection System (if installed)
 - Lead-in surge protection
 - Power connection to the BDA
 - Installation of conduits and equipment in fire-rated enclosures or rooms

- 2. **Final Inspection**
 - All electrical components are in place.
 - Label "BDA" circuit breakers.

Note: This checklist is a minimum checklist. Coordinate with the local Electrical AHJ for additional checklist items.

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2B.2.3 NFPA 72 (2016), NFPA 1221 (2016) Inspection - Elevator

1. Rough System Inspection

- Conduit and cable installed in elevator shafts.

2. Final Inspection

- Antenna(s) installed in the elevator shaft.

Note: This checklist is a minimum checklist. Coordinate with the local Elevator AHJ for additional checklist items.

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2B.2.4 NFPA 72 (2016), NFPA 1221 (2016) Inspection-Building (Structural)

Rough Inspections:

Structural

- 1. Inspection for all fire-rated enclosures/penetrations for cables and BDA room (FBC BC 110.3)
 - a. Framing inspection, if applicable
 - b. Drywall inspection, if applicable
- 2. In progress roof penetrations (if applicable, FBC BC 110.3)

Final Inspections:

Structural

- 1. Antenna mast installation (FBC BC 110.3)
- 2. Inspection for all fire-rated enclosures/penetrations for cables and BDA room (FBC BC 110.3)
- 3. Roof final (if applicable, FBC BC 110.3)

Note: This checklist is a minimum checklist. Coordinate with the local AHJ for additional checklist items.

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2B.2.5 NFPA 72 (2016), NFPA 1221 (2016) Inspection - FCC AHJ (License Holder)

1. Initial Inspection

- 1. The system shall never be energized for testing or operation until written, or onsite approval is obtained from the FCC AHJ (License Holders).
(FBC BC 1.118.4.2.2)
- 2. Prior to the initial inspection, a letter from the Engineer of Record stating that the installation is complete and ready to be energized for testing shall be received by the FCC AHJ (License Holders). The system settings and pictures of the installed major components shall also be provided to the FCC AHJ (License Holders). (FBC BC – 1.118.4.2.1)

The following components shall be included in the letter and pictures:

- (1) BDA with information
Permit Number; Serviced by _____; Telephone _____
 - (2) Enclosures with battery charger and batteries installed, wired with a label showing the battery installation date.
 - (3) The Dedicated annunciator shall be wired. The system shall be constructed and programmed to the FACP and the annunciator.
 - (4) BDA and FACP rooms shall be fire rated. Doors shall also be fire rated.
 - (5) All equipment shall be properly grounded per TIA 607 and Motorola R56 Standards.
 - (6) Antenna mast shall be grounded and connected to the NFPA 780 Lightning Protection System (if installed).
 - (7) Antenna shall have surge protection installed and wired.
 - (8) Antenna(s), if installed in the elevator shaft, shall have the approval of the Elevator Inspector.
 - (9) Junction boxes connected to the riser coaxial cables to the horizontal cables shall be installed and wired.
 - (10) All electrical rough inspections shall be completed.
- 3. The contractor shall coordinate the inspection with all responsible parties.
The following shall be present at a minimum:
 - Owners representative
 - Electrical Contractor
 - Fire Alarm Contractor
 - BDA Vendor representative with analyzer and computer to gain access to the BDA program to check levels and settings.
 - System Engineer of Record, if requested by the AHJ.
 - Electrical AHJ
 - Fire Official AHJ
 - FCC AHJ(s) (License Holders) (There may be more than one.)
 - 4. The Initial Inspection shall include the following:
 - (1) The System shall be energized for the first time.
 - (2) Items (1) through (10) in Section 2 above shall be inspected for compliance.
 - (3) Acceptable dB levels shall be spot checked. Include stairwells and elevator cab.
 - (4) Check the noise floor of the BDA transmitter. The noise floor shall be -100 dB to -105 dB or less than a 5 dB increase in the noise floor.
 - (5) System Engineer of Record shall attend all inspections, if requested by the AHJ.

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2B.2.5 NFPA 72 (2016), NFPA 1221 (2016) Inspection - FCC AHJ (License Holder) (cont.)

2. Final Inspection

This Inspection is a joint effort between the Fire Official and the FCC AHJ (License Holders). Prior to the final inspection, the contractor shall provide to the Fire Official and to the FCC AHJ (License Holders) the following documentation showing that the building is ready for the final inspection.

After passing the initial inspection, the contractor shall submit to the FCC AHJ (License Holder) a Post Heat Map Study to show that all areas are covered per the code. A letter from the Engineer of Record shall state that the System is completed, fully operational, and ready for the final inspection.

The contractor shall coordinate the inspection with all responsible parties. The following shall be present at a minimum:

- Owners representative
- Electrical Contractor
- Fire Alarm Contractor
- BDA Vendor representative with analyzer and computer to gain access to the BDA program to check levels and settings.
- System Engineer of Record, if requested by the AHJ
- Electrical AHJ
- Fire Official AHJ
- FCC AHJ(s) (License Holders) (There may be more than one.)

Final Inspection:

- (1) Building Radio Coverage Inspection
 - 99% in critical areas
 - 90% in general building areas
 - DAQ 3.0 or better
- (2) All dB levels are acceptable.
- (3) Remote annunciator shall be functional.
- (4) Connection to the fire alarm shall be functional.
- (5) Owner shall provide proof of a signed service agreement with the BDA vendor.

Note: This checklist is a minimum checklist. Coordinate with the local FCC License Holder AHJ for additional checklist items.

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Broward County Board of Rules and Appeals
Two-Way Radio Communications Enhancement Systems
BORA RCES Guidelines

Part 2C. Recommended Checklists for NFPA 72 (2019), NFPA 1221 (2019)

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2C.1.1 NFPA 72 (2019), NFPA 1221 (2019) Plan Review - Fire

Plans shall include the following information:

- 1. Building owner and address
- 2. Written sequence of operation
- 3. Signature and seal of the Engineer of Record with experience and training in electrical engineering. The name, PE number, business name, CA number, address, and contact information shall be shown on the plans. The AHJ may require that the Engineer of Record provide evidence of experience and training in Electrical Engineering. (NFPA 72-10.5)
- 4. Applicable codes and edition dates
- 5. Building description showing building construction, building occupancy, total square footage, number of floors, total height of building (NFPA 1-1.7.1) (NFPA 72-7.4)
- 6. Floor plans showing device locations, fire-rated enclosures, conduit runs, and propagation modeling, etc. (NFPA 1) (NFPA 1-1.7.12) (NFPA 72-7.4)
- 7. Riser plans for systems (NFPA 1-1.7.12) (NFPA 72-7.4)
- 8. Specifications with manufacturer's parts numbers (NFPA 1-1.7.12) (NFPA 72-7.4)
- 9. Firewall penetration details, etc. (NFPA 1-12.7.5.1, NFPA 1-1.7.12) (NFPA 72-7.4)
- 10. Identify the panel and circuit breaker; show panel location on plan. (NFPA 1-1.7.12) (NFPA 72-7.4)
- 11. Show circuit breaker lock. (NFPA 1-1.7.12) (NFPA 72-10.6.5.4)
- 12. Provide an information binder stored next to the BDA. Information shall include (NFPA 72-7.5):
 - (1) As-built drawings
 - (2) Manufacturer's data sheets and specs
 - (3) Heat maps with the final signal strength readings
 - (4) Final signal strength measurements (dB)
 - (5) Maintenance contract
 - (6) Broward County RESC, FCC AHJ (License Holders), all other approvals, and elevator variance letter, if applicable.
 - (7) Maintenance Repair Log
- 13. The backbone, antenna distribution, radiating, or any fiber optical cables shall be rated as plenum cable. (NFPA 1221-9.6.2.1)
- 14. Backbone cables shall be routed through an enclosure matching the building's fire rating. (NFPA 1221-9.6.2. 3)
- 15. Radio coverage shall be a minimum of 99% in critical areas, such as the fire command center(s), the fire pump room(s), exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the AHJ and 90% in general building areas. (NFPA 1221-9.6.7)
- 16. Signal strength inbound shall be a minimum of DAQ 3.0. (NFPA 1221-9.6.8.1)
Signal strength outbound shall be a minimum of DAQ 3.0. (NFPA 1221-9.6.8.2)
- 17. Donor antenna isolation shall be a minimum of 20 dBm above the inside antennas. (NFPA 1221-9.6.9)
- 18. System radio frequencies; system shall be capable of transmitting all public safety radio frequencies assigned to the FCC AHJ and be capable of using any modulation technology. (NFPA 1221-9.6.10.1)
- 19. Frequency changes. System shall be capable of upgrading. (NFPA 1221-9.6.10.2)
- 20. System Components: Components shall be approved and compatible with the Public Safety Radio System. (NFPA 1221-9.6.11) (NFPA 1-1.4)

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2C.1.1 NFPA 72 (2019), NFPA 1221 (2019) Plan Review - Fire (cont.)

- 21. All repeaters, transmitter receptacles, signal booster components and battery system components shall be in a NEMA 4, 4X enclosure. (NFPA 1221-9.6.11.2.1) (NFPA 1-1.7.12) (NFPA 1-1.4)
- 22. Batteries that require ventilation shall be stored in NEMA 3R-type enclosures. (NFPA 1221-9.6.11.2.2) (NFPA 1-1.4)
- 23. Power supplies shall have at least two independent sources. (NFPA 1221-9.6.12)
- 24. The primary power source shall be supplied from a dedicated circuit and shall comply with NFPA 72. (NFPA 1221-9.6.12.1)
- 25. The secondary power source shall consist of one of the following (NFPA 1221-9.6.12.2):
 - (1) Battery with at least 12 hours of operation at 100%
 - (2) Battery with at least 24 hours of operation at 100%
 - Legally required generator with at least 12 hours of operation at 100%
- 26. System Monitoring: The fire alarm system shall monitor the following items as a minimum (NFPA 1221-9.6.13.1):
 - (1) Monitoring for integrity of the system shall comply with NFPA 72-10
 - (2a) Donor antenna malfunction
 - (2b) Active RF emitting device failure
 - (2c) Low battery capacity indicator
 - (2d) Active system component failure
 - (3a) Loss of normal AC power
 - (3b) Failure of battery charger
 - (4) Communication link between the FACP and the BDA shall be monitored for integrity.
- 27. Dedicated Panel (annunciator panel) shall show (NFPA 1221-9.6.13.2):
 - (1) Normal AC power
 - (2) Loss of normal power
 - (3) Battery charger failure
 - (4) Low battery capacity (70%)
 - (5) Donor antenna malfunction
 - (6) Active RF emitting device malfunction
 - (7) System component malfunction
 - (8) Communication link between the Dedicated Monitoring Panel and the BDA shall be monitored for integrity.
- 28. Technical Criteria (NFPA 1221-9.6.14)
 - (1) Frequencies required
 - (2) Location and effective radiated power (ERP) of the FCC AHJ radio site
 - (3) Maximum propagation delay less than 30 micro-seconds
 - (4) List of specifically approved system components
 - (5) Other support technical information (Battery calculations) (NFPA 72-10.6.7.2.1)
- 29. When an elevator(s) is(are) present in the building, an antenna is typically required to be mounted in the elevator shaft(s) to get coverage inside the elevator car(s). A note on the plan shall be provided: "Contractor shall obtain written approval from the elevator inspector prior to any work inside an elevator shaft or machine room. (ASME A17.1)
- 30. Systems shall have a Lightning Protection System that complies with NFPA 780. (NFPA 1221-9.6.3)

Note: This checklist is a minimum checklist. Coordinate with the local Fire AHJ for additional checklist items.

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2C.1.2 NFPA 72 (2019), NFPA 1221 (2019) Plan Review - Electrical

Plans shall include the following information:

- 1. Building owner and address
- 2. Copy of the contract with the owner or GC (FAC 61G6)
- 3. Signature and seal of the Engineer of Record with experience and training in electrical engineering. The name, PE number, business name, CA number, address, and contact information shall be shown on the plans. (FBC BC 118.1.4) (61G15-30.003(2))
- 4. Applicable codes and edition dates (61G15-30.003(1b))
- 5. Building description showing building construction, building occupancy, total square footage, number of floors, total height of building (FAC 61G15)
- 6. Floor plans showing device locations, fire-rated enclosures, conduit runs, and propagation modeling, etc. (FBC BC 118.2.1.4)
- 7. Riser plans for systems (FAC 61G15)
- 8. Specifications with manufacturer's parts numbers (FAC 61G15-~~33~~)
- 9. Details, including firewall penetration, etc. (FAC 61G15) (NFPA 70 820-26)
- 10. Grounding and mounting details for antenna, mast, surge protection, BDA, power supply, battery enclosure, etc. (FAC 61G15) (NFPA 70)
- 11. Antenna NFPA 780 protection, if existing. If not existing, add system. (FAC 61G15) (NFPA 780)
- 12. The BDA enclosure shall be painted red and a sign shall show permit number, vendor name, and telephone number. (FBC BC 118.2.1.8)
- 13. Show how the system components are wired to power (120V). (NFPA 70-110.2(B))
- 14. Circuit shall have an isolated ground, if required by the manufacturer. (NFPA 70)
- 15. Listing and labeling requirements (NFPA 70-110.2)
- 16. Identify minimum conduit sizes and minimum conduit 90-degree bend radiuses. (NFPA 70-110.3)
- 17. System equipment shall be installed in an air-conditioned and mechanically ventilated room where the manufacturer's installation document requires a temperature limitation and/or ventilation. (NFPA 70-110.3)

Note: This checklist is a minimum checklist. Coordinate with the local Electrical AHJ for additional checklist items.

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2C.1.3 NFPA 72 (2019), NFPA 1221 (2019) Plan Review - Elevator

Plans shall include the following information:

A variance shall be obtained from the Broward County Elevator Inspection Services Section at Permitting prior to any work inside an elevator shaft or elevator machine room. The variance shall be to install an antenna in the elevator shaft(s) (ASME A17.1).

Note: The elevator code does not allow the elevator shaft to be used for coaxial cable risers.
(ASME A17.1.2.8.1)

Note: This checklist is a minimum checklist. Coordinate with the local Elevator AHJ for additional checklist items.

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2C.1.4 NFPA 72 (2019) Plan Review – Building (Structural)

- 1. Structural design calculations for antenna mast (if applicable, FBC BC 107.3.5)
- 2. Attachment and roof penetration details on plan for antenna mast (if applicable, FBC BC 107.3.5)
- 3. Floor plans showing fire-rated enclosures for cables and BDA room, including fire-rated UL designs (if applicable, FBC BC 107.3.5)
- 4. Riser plans showing fire-rated enclosure for cable, including fire-rated UL designs (if applicable, FBC BC 107.3.5)
- 5. Firewall penetrations, including UL designs (if applicable, FBC BC 107.3.5)

Note: This checklist is a minimum checklist. Coordinate with the local AHJ for additional checklist items.

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2C.1.5 NFPA 72 (2019), NFPA 1221 (2019) Plan Review – FCC AHJ (License Holder)

Plans shall include the following information:

- 1. Building owner and address
- 2. Building description showing building construction, building occupancy, total square footage, number of floors, total height of building
- 3. Applicable codes and edition dates
- 4. Floor plans showing device locations, fire-rated enclosures, conduit runs, and propagation modeling, etc. Propagation (heat) map drawings shall include the following (FBC BC 118.2.1.4):
 - Indoor Prediction Legend
 - Pictogram Legend
 - Calculations Legend
 - Number of Channels
 - Predictive propagation shown on floor plans
 - Name of certified designer and company
 - Materials Legend
 - Cables Legend
 - Frequencies or frequency bands for the Public Radio System(s)
- 5. Riser plans for systems
- 6. Specifications with manufacturer's parts numbers
- 7. Manufacturer's specifications for equipment; include equipment temperature limits.
- 8. Grounding and mounting details for antenna, mast, surge protector, BDA, power supply, battery enclosure. (IEEE 1692, TIA 569, TIA 607)
- 9. Notes on plans shall state:

"The system shall never be energized for testing or operation until written, or on site, approval is obtained from all applicable FCC License Holders."
- 10. The BDA enclosure shall be painted red and a sign shall show permit number, vendor name and telephone number.
- 11. Signal strength inbound shall be a minimum of -95 dBm. Signal strength outbound shall be a minimum of -95 dBm.
- 12. Isolation shall be a minimum of 15 dBm above the (maximum) signal booster gain under all operating conditions.
- 13. System radio frequencies: system shall be capable of transmitting (transporting) all public safety radio frequencies used by the FCC AHJ (License Holder) and be capable of using any modulation technology.
- 14. Frequency changes. System shall be capable of upgrading.
- 15. System Components: Components shall be approved and compatible with the Public Safety Radio System. Show the propagation delay. Signal Boosters shall have FCC Certification. Power supplies shall have at least two independent supplies. Battery shall provide twelve (12) hour minimum operational run time. (Provide a battery calculation at 100%)
- 16. Technical Criteria
 - (1) Frequencies or frequency bands required
 - (2) Location and effective radiated power (ERP) of the FCC AHJ radio site
 - (3) Maximum propagation delay (30 microseconds)
 - (4) List of specifically approved system components
 - (5) Other supporting technical information

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2C.1.5 NFPA 72 (2019), NFPA 1221 (2019) Plan Review – FCC AHJ (License Holder) (cont.)

- 17. When an elevator(s) is(are) present in the building, an antenna is typically required to be mounted in the elevator shaft(s) to get coverage inside the elevator car(s). A note on the plan shall be provided: “Contractor shall obtain written approval from the elevator inspector prior to any work inside an elevator shaft or machine room.
- 18. Other industry standards include IEEE 1692, TIA 569, and TIA 607.

Note: This checklist is a minimum checklist. Coordinate with the local FCC AHJ (License Holder) for additional checklist items.

See Part 3. Additional Information attachments:

3.2 FCC AHJ (License Holder) Additional Requirements

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2C.2.1 NFPA 72 (2019), NFPA 1221 (2019) Inspection - Fire

Final Inspection

Property Information

Property Name: _____ Permit #: _____ Inspection Date: _____
Property Address: _____

Contact Information:

BDA Equipment Provider: _____
BDA Licensed Contractor: _____
Fire Alarm Licensed Contractor: _____
Fire Alarm Monitoring Company: _____
Engineer of Record: _____

- 1. The latest approved record drawings, operation manuals, and maintenance manuals are on the site.
- 2. The following representatives are on the site for the inspection:
 - Fire Inspector
 - Broward County RESL (ORCAT)
 - Ft. Lauderdale TeleCom
 - Electrical Inspector
 - BDA equipment provider (systems integrator)
 - BDA Licensed Contractor
 - Fire Alarm Licensed Contractor
 - Engineer of Record, only for re-inspection, If required by the AHJ
 - Building Owner Representative
- 3. Fire Rated Enclosure openings and penetrations are properly sealed (NFPA 1-12.7.5.1).
- 4. The installation complies with the pathway of survivability as shown on the approved record drawings.
Note: A level 1 pathway requires coaxial cables installed in metal raceways. (NFPA 1221-5.10)
- 5. The system components match the approved record drawings for manufacturer and part numbers.
(NFPA 1221-9.6.11.1) (NFPA-1.1.4)
- 6. The BDA enclosure shall be painted red and a sign shall show permit number, vendor name and telephone number. (FBC 118.2.1.8)
- 7. Provide an information binder stored next to the BDA. Information shall include:
(NFPA 72-14.6.1.1) (FBC 118)
 - (1) As-built drawings
 - (2) Manufacturer's data sheets and specs
 - (3) Heat map
 - (4) Final signal strength measurement (dB)
 - (5) Maintenance contract
 - (6) Broward County RESC, FCC AHJ (License Holders), all other approvals and elevator variance letter, if applicable.
 - (7) Maintenance Repair Log
- 8. Pathway survivability level has been removed.
- 9. The backbone and antenna distribution cables shall be rated as plenum cables. (NFPA 1221-9.6.2.1.)
- 10. Backbone cables shall be routed through an enclosure matching the building's fire rating.
(NFPA 1221-9.6.2.3)

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2C.2.1 NFPA 72 (2019), NFPA 1221 (2019) Inspection - Fire (cont.)

- 11. Radio coverage shall be a minimum of 99% in critical areas, such as the fire command center(s), the fire pump room(s), exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the AHJ and 95% in general building areas. (NFPA 1221-9.3.1.2.1)
- 12. Signal strength inbound shall be a minimum of DAQ 3.0. (NFPA 1221-9.6.8.1)
Signal strength outbound shall be a minimum of DAQ 3.0. (NFPA 1221-9.6.8.2)
- 13. Isolation shall be a minimum of 20 dBm above the signal booster gain under all operating conditions. (NFPA 1221-9.6.9)
- 14. System radio frequencies: system shall be capable of transmitting all public safety radio frequencies assigned to the FCC AHJ (License Holder) (NFPA 1221-9.6.10.1)
- 15. Frequency changes: System shall be capable of upgrading. (NFPA 1221-9.6.10.2)
- 16. System Components: Components shall be approved and compatible with the Public Safety Radio System. (NFPA 1221-9.6.11)
- 17. All repeaters, transmitter receptacles, signal booster components and battery system components shall be in a NEMA 4, 4X enclosure. (NFPA 1221-9.6.11.2.1) Where the battery system components are listed to the UL 2524 Standard, a NEMA 3R enclosure is permitted. (NFPA 1221-9.6.11.2.2)
- 18. Power supplies shall have at least two independent sources. (NFPA 1221-9.6.12)
- 19. The primary power source shall be supplied from a dedicated circuit and shall comply with NFPA 72. (NFPA 1221-9.6.12.1)
- 20. The secondary power source shall consist of one of the following (NFPA 1221-9.6.12.2):
 - (1) Battery with at least 12 hours of operation at 100%
 - (2) Battery with at least 24 hours of operation at 100%
Legally required generator with at least 12 hours of operation at 100%
- 21. System Monitoring: The fire alarm system shall monitor the following items as a minimum (NFPA 1221-9.6.13.1):
 - (1) Monitoring for integrity of the system shall comply with NFPA 72-10
 - (2a) Donor antenna malfunction
 - (2b) Active RF emitting device failure
 - (2c) Low battery capacity indicator
 - (2d) System component failure
 - (3a) Loss of normal AC power
 - (3b) Failure of battery charger
 - (4) Communication link between the FACP and the BDA shall be monitored for integrity.
- 22. Dedicated Panel (annunciator panel) shall show (Auto-notification within 3 minutes, 20 seconds) (NFPA 1221-9.6.13.2):
 - (1) Normal AC power
 - (2) Loss of normal power
 - (3) Battery charger failure
 - (4) Low battery capacity
 - (5) Donor antenna malfunction
 - (6) Active RF emitting device malfunction
 - (7) System component malfunction
 - (8) Communication link between the FACP and the BDA shall be monitored for integrity.

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2C.2.1 NFPA 72 (2019), NFPA 1221 (2019) Inspection - Fire (cont.)

- 23. Signage is provided to locate the BDA.
Fire Department signal booster permit number, service provider, and contact telephone numbers are shown. (FBC 118.2.1.8) (NFPA 72-10.18.3.2)
- 24. Completed NFPA documentation specific to this system is provided. [NFPA 72-7.8.2; figure 7.8.2(a) and (b)]
- 25. Documentation is provided showing that a maintenance and service agreement has been entered into between the property owner and the provider of the BDA System. (NFPA 72-14.4.10.1) (NFPA 72-14.4.10.6) (NFPA 72-14.6.1.1)
- 26. DAQ, Delivered Audio Quality, for the system is a minimum of DAQ 3.0. Include all floors, critical areas, elevator cabs, and general building areas. (NFPA 1221-9.6.7.3)
- 27. Where required by the manufacturer, the power receptacle shall be an isolated ground type receptacle and shall be connected to an isolated ground. (NFPA 1221-5.8.2)
- 28. Systems shall have a Lightning Protection System that complies with NFPA 780. (NFPA 1221-9.6.3)

Note: This checklist is a minimum checklist. Coordinate with the local Fire AHJ for additional checklist items.

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2C.2.2 NFPA 72 (2019), NFPA 1221 (2019) Inspection - Electrical

- 1. **Rough Electrical Inspection** (FBC BC (2017)-1.110.8.5)
 - Installation of conduits
 - Installation of coaxial cables
 - Panels, BDA, and BBU shall be grounded.
 - Antenna and mast
 - Grounding, Lightning Protection System (if installed)
 - Lead-in surge protection
 - Power connection to the BDA
 - Installation of conduits and equipment in fire-rated enclosures or rooms

- 2. **Final Inspection**
 - All electrical components are in place.
 - Label "BDA" circuit breakers.

Note: This checklist is a minimum checklist. Coordinate with the local Electrical AHJ for additional checklist items.

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2C.2.3 NFPA 72 (2019), NFPA 1221 (2019) Inspection - Elevator

1. Rough System Inspection

- Conduit and cable installed in elevator shafts.

2. Final Inspection

- Antenna(s) installed in the elevator shaft.

Note: This checklist is a minimum checklist. Coordinate with the local Elevator AHJ for additional checklist items.

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2C.2.4 NFPA 72 (2019), NFPA 1221 (2019) Inspection-Building (Structural)

Rough Inspections:

Structural

- 1. Inspection for all fire-rated enclosures/penetrations for cables and BDA room (FBC BC 110.3)
 - a. Framing inspection, if applicable
 - b. Drywall inspection, if applicable
- 2. In progress roof penetrations (if applicable, FBC BC 110.3)

Final Inspections:

Structural

- 1. Antenna mast installation (FBC BC 110.3)
- 2. Inspection for all fire-rated enclosures/penetrations for cables and BDA room (FBC BC 110.3)
- 3. Roof final (if applicable, FBC BC 110.3)

Note: This checklist is a minimum checklist. Coordinate with the local AHJ for additional checklist items.

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2C.2.5 NFPA 72 (2019), NFPA 1221 (2019) Inspection - FCC AHJ (License Holder)

1. Initial Inspection

- 1. The system shall never be energized for testing or operation until written, or onsite approval is obtained from the FCC AHJ (License Holders).
(FBC BC 1.118.4.2.2)
- 2. Prior to the initial inspection, a letter from the Engineer of Record stating that the installation is complete and ready to be energized for testing shall be received by the FCC AHJ (License Holders). The system settings and pictures of the installed major components shall also be provided to the FCC AHJ (License Holders). (FBC BC – 1.118.4.2.1)

The following components shall be included in the letter and pictures:

- (1) BDA with information
Permit Number; Serviced by _____; Telephone _____
 - (2) Enclosures with battery charger and batteries installed, wired with a label showing the battery installation date.
 - (3) The Dedicated annunciator shall be wired. The system shall be constructed and programmed to the FACP and the annunciator.
 - (4) BDA and FACP rooms shall be fire rated. Doors shall also be fire rated.
 - (5) All equipment shall be properly grounded per TIA 607 and Motorola R56 Standards.
 - (6) Antenna mast shall be grounded and connected to the NFPA 780 Lightning Protection System (if installed).
 - (7) Antenna shall have surge protection installed and wired.
 - (8) Antenna(s), if installed in the elevator shaft, shall have the approval of the Elevator Inspector.
 - (9) Junction boxes connected to the riser coaxial cables to the horizontal cables shall be installed and wired.
 - (10) All electrical rough inspections shall be completed.
- 3. The contractor shall coordinate the inspection with all responsible parties.
The following shall be present at a minimum:
 - Owners representative
 - Electrical Contractor
 - Fire Alarm Contractor
 - BDA Vendor representative with analyzer and computer to gain access to the BDA program to check levels and settings.
 - System Engineer of Record, if requested by the AHJ.
 - Electrical AHJ
 - Fire Official AHJ
 - FCC AHJ(s) (License Holders) (There may be more than one.)
 - 4. The Initial Inspection shall include the following:
 - (1) The System shall be energized for the first time.
 - (2) Items (1) through (10) in Section 2 above shall be inspected for compliance.
 - (3) Acceptable dB levels shall be spot checked. Include stairwells and elevator cab.
 - (4) Check the noise floor of the BDA transmitter. The noise floor shall be -100 dB to -105 dB or less than a 5 dB increase in the noise floor.
 - (5) System Engineer of Record shall attend all inspections, if requested by the AHJ.

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2B.2.5 NFPA 72 (2019), NFPA 1221 (2019) Inspection - FCC AHJ (License Holder) (cont.)

2. Final Inspection

This Inspection is a joint effort between the Fire Official and the FCC AHJ (License Holders). Prior to the final inspection, the contractor shall provide to the Fire Official and to the FCC AHJ (License Holders) the following documentation showing that the building is ready for the final inspection.

After passing the initial inspection, the contractor shall submit to the FCC AHJ (License Holder) a Post Heat Map Study to show that all areas are covered per the code. A letter from the Engineer of Record shall state that the System is completed, fully operational, and ready for the final inspection.

The contractor shall coordinate the inspection with all responsible parties. The following shall be present at a minimum:

- Owners representative
- Electrical Contractor
- Fire Alarm Contractor
- BDA Vendor representative with analyzer and computer to gain access to the BDA program to check levels and settings.
- System Engineer of Record, if requested by the AHJ
- Electrical AHJ
- Fire Official AHJ
- FCC AHJ(s) (License Holders) (There may be more than one.)

Final Inspection:

- (1) Building Radio Coverage Inspection
 - 99% in critical areas
 - 90% in general building areas
 - DAQ 3.0 or better
- (2) All dB levels are acceptable.
- (3) Remote annunciator shall be functional.
- (4) Connection to the fire alarm shall be functional.
- (5) Owner shall provide proof of a signed service agreement with the BDA vendor.

Note: This checklist is a minimum checklist. Coordinate with the local FCC License Holder AHJ for additional checklist items.

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Broward County Board of Rules and Appeals
Two-Way Radio Communications Enhancement Systems
BORA RCES Guidelines

Part 3. Additional Information Attachments

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Additional Information Attachments

These attachments are for informational, explanation, and guidance purposes only.

These attachments are not code requirements.

These attachments shall be updated and expanded in the future to reflect current technologies and standards.

The interpretation of any code item shall be completed by the specific Authority Having Jurisdiction (AHJ).

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Additional Information Attachments (cont.)

3.1 Applicable Codes and Edition Dates

- A) The Florida Fire Prevention Code had adopted NFPA 72, 2013.
- B) The Florida Fire Prevention Code does allow the Florida Engineer of Record to select a later NFPA code for a specific project (FPPC (2017) 1, 4 Equivalencies...).
- C) The Florida Engineer of Record may select one of the following sets of codes:
 - NFPA 72 (2013)
 - or
 - NFPA 72 (2016) and NFPA 1221 (2016)
 - or
 - NFPA 72 (2019) and NFPA 1221 (2019)
- D) This selection shall be identified on the system drawings for permit and shall be approved by the Fire AHJ.

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Additional Information Attachments (cont.)

3.2 FCC AHJ (License Holder) Additional Requirements

1. The FCC AHJ (License Holder) does not fall under the direction of the Broward County Board of Rules and Appeals. Each FCC AHJ (License Holder) has specific requirements and guidelines that shall be followed.

2. Refer to the following FCC License Holder requirements:

Broward County RESC Communications Requirements dated 2019

City of Fort Lauderdale Communications Requirements dated 2019-10-23

3. The following industry standards are part of the FCC AHJ's (License Holder's) requirements:

IEEE 1692 (2011) Guide for the Protection of Communication Installations from Lightning Effects

TIA/ANSI/EIA 569-C (2012) Telecommunications Pathways and Spaces

TIA/ANSI/EIA 607-B (2011) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

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Additional Information Attachments (cont.)

3.3 OSHA Standards and NRTL's

A) All products shall be approved by the AHJ.

1) Fire AHJ (Applicable Codes)

a) NFPA 72 (2013, 2016, 2019)

b) NFPA 1221 (2016 ,2019)

3. Definitions

3. Definitions

3.2.1 Approvals

3.2.1 Approvals

3.2.1 AHJ

3.2.2 AHJ

3.2.4 Labeled

3.2.3 Labeled

3.2.5 Listed

3.2.4 Listed

10.3.1 ...Equipment...shall be listed

9.6.11.1 ...Component Approval

...shall be approved by AHJ

2) Electrical AHJ Applicable Code 100. Definitions Approval, AHJ, Labeled, Listed 110.2 Approval 110.3 Examination, Identification

B) OSHA Standards:

OSHA maintains a list of Test Standards Two of these Test Standards include UL 60950 and UL 2524

C) OSHA NRTL's:

OSHA maintains a list of approved "Nationally Recognized Testing Laboratories" (NRTL's). These laboratories test products to the OSHA Test Standards and provide the listing and labeling.

D) Role of UL (Underwriter's Laboratories):

UL has two (2) companies as follows:

1) UL Inc. (UL.org)

Writes the Test Standards for OSHA and is accredited by ANSI

UL 60950 Standards

UL 2524 Standards

2) UL LLC. (UL.com)

a) Provides testing, listing, and labeling for products in accordance with OSHA Standards

b) One of the eighteen (18) OSHA NRTL's in the USA

E) Listed versus Non-Listed Products:

1) Listed products:

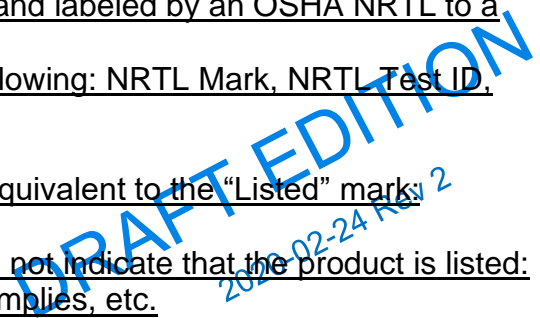
a) Products that have been tested, listed, and labeled by an OSHA NRTL to a specific OSHA Standard

b) Product name plate shall include the following: NRTL Mark, NRTL Test ID, "Listed", OSHA Standard

2) Non-Listed Products:

The following marks on a product are not equivalent to the "Listed" mark: Recognized, or Classified.

The following terms shown on a product do not indicate that the product is listed: Approved, Tested, Certified, Conforms, Complies, etc.



Additional Information Attachments (cont.)

3.4 Product Compatibility

Equipment without UL Standards:

There are many components of an RCES that do not fall into a category having a UL Standard. In these cases, the AHJ should use NFPA 1-1.4 Equivalencies, Alternatives, and Modifications to enable the usage of these components in an RCES.

See the attached product compatibility forms.

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3.4 Two-Way Radio Communications Enhancement Systems Product Compatibility Draft Edition 2019-06-14					
Item	Manufacturer	Product Name	Part Number	UL Standard	NRTL Listing
BDA/Repeater				60950 2524	
Power Supply					
Charger					
Battery/Enclosure					
Remote Annunciator					
Surge Protection					
Donor Antenna				N/A	-
In-Building Antenna				N/A	-
Couplers				N/A	-
Connectors				N/A	-
Splitters				N/A	-
Ground Kit				NA	-
Mast				NA	-
Outside Cable					
Plenum Cable					
The above items are compatible for use with the BDA. This form shall be filled out by the BDA manufacturer.					
BDA Mfgr. _____ Address _____ City/State _____ Rep Name _____ Title _____ Date _____			Florida Engineer of Record: _____ Name _____ PE # _____ Company _____ CA # _____ Date _____		

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Two-Way Radio Communications Enhancement Systems Product Compatibility					
Item	Manufacturer	Product Name	Part Number	UL Standard	NRTL Listing
BDA/Repeater	BDA Corp.	Repeater	BDA-XXX	60950 2524	UL/ETL
Power Supply UPS	UPS Corp.	UPS	Incl BDA-XXX		
Charger	C Corp.	Charger	Incl BDA-XXX		
Battery/Enclosure	B/E Corp.	Battery Backup	BDA-XXX		
Remote Annunciator	RA Corp.	Annunciator			
Surge Protection	Polyphaser	Surge Protector		NA	
Donor Antenna	Sinclair	800/700 MHZ	SY407-SF2SNM	NA	-
In-Building Antenna	Galtronics	700/800 MHZ	PEAR-S5379	NA	-
Couplers	Micro Lab	2-Way	D2-85FN	NA	-
Connectors	RFS	N-Male	NM-LCF12-D01	NA	-
Splitters	Micro Lab	Power Splitter Fixed Ratio	DN-XXFN	NA	-
Ground Kit	CI Wireless.com	1/2" Ground Kit Tinned	SCGK12	NA	-
Mast				NA	-
Outside Cable	RFS	1/2" UV Cable	ICA12-50J		ETL
Plenum Cable	RFS Commscope	1/2" Plenum Cable 1/2" Plenum Cable	LCF12-50JPL HL4- 50A		ETL ETL
Busbar	CI Wireless	Tinned Copper Busbar	GB212-NH	NA	

The above items are compatible for use with the BDA. This form shall be filled out by the BDA manufacturer.

BDA Mfgr. <u>BDA Corp</u> Address <u>Any Street</u> City/State <u>Any Town, Any State</u> Rep Name _____ Title _____ Date _____	Florida Engineer of Record: Name _____ PE # _____ Company _____ CA # _____ Date _____
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Additional Information Attachments (cont.)

3.5 Battery Enclosures

The battery enclosure type is determined by the NFPA code and issue date. The following codes apply:

1. NFPA 72.24.5.2.5.2 (2013)
The battery enclosure shall be a NEMA 4, 4X type.
2. NFPA 1221-9.6.11.2 (2016)
The battery shall be stored in a NEMA 4, 4X type enclosure.
3. NFPA 1221-9.6.11.2.2 (2019)
The battery shall be stored in a NEMA 4, 4X type enclosure.
NFPA 1221-9.6.11.2.2
“Batteries that require ventilation shall be stored in a NEMA 3R type enclosure.”

All rechargeable batteries manufactured today, including “sealed” batteries, require ventilation. The 2019 Code and the UL 2524 Standard addresses this issue and requires a NEMA 3R type enclosure for batteries requiring ventilation.

When a project is permitted under NFPA 72 (2013) or NFPA 1221 (2016), approval from the Fire AHJ is required to use the NEMA 3R type enclosure. The Fire AHJ may approve the NEMA 3R type enclosure when the BDA equipment is listed per UL 2524 and batteries requiring ventilation are used, based on NFPA 1-1.4, Equivalencies, Alternatives, and Modifications.

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Additional Information Attachments (cont.)

3.6 Drawing Set Numbering Option

Drawing numbers for plans should be set up in a logical sequence. Care should be taken to select the first and second letters to minimize confusion in reviewing drawings.

The following are typical drawing letters:

- A: Architectural
- C: Civil
- E: Electrical
- F, FP: Fire Protection
- FA: Fire Alarm
- I: Interior
- M: Mechanical
- P: Plumbing
- Q: Equipment
- T: Telecommunications

FC should be used for Fire RCES Drawings.

<u>Drawing Number</u>	<u>Description</u>
FC	Fire Communication Drawing Set
FC-1.XX	Title Sheet, Drawing Index, Property Information, Project Team, Applicable Codes with Edition Dates, Scope of Work, Specific Requirements, Legend, Notes, Specifications
FC-2.XX	Floor Plans with Fire Rating of Walls, Equipment Locations, Conduit Runs
FC-3.XX	Conduit Riser, Details
FC-4.XX	Propagation Plan, System Riser Diagrams, Equipment Lists, Link Budgets, Etc.
FC-5.XX	Product Compatibility List Manufacturer's Specs for Equipment

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Additional Information Attachments (cont.)

3.7 Conditioned Space for Equipment

Equipment shall be installed in a space that does not exceed the temperature limitations as indicated in the manufacturer's specifications and requirements (NFPA 70-110.3(B)).

The system also has a battery backup system. These systems require mechanical ventilation for operation.

Most, if not all, RCES systems are installed in an air-conditioned space to meet the temperature requirements in the State of Florida.

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Additional Information Attachments (cont.)

3.8 Lightning Protection

NFPA 72 (2013); NFPA 1221.9.6.3 (2016, 2019)

A) Systems, with the exception of hospitals, nursing homes, or schools (as required by the FBC 449, 450, 453), installed under NFPA 72 (2013) are not required to have a lightning protection system that complies with NFPA 780. NFPA 72 (2013).

However, if the building has a Lightning Protection System that complies with NFPA 780, then the new BDA System shall be protected by the Lightning Protection System and shall comply with NFPA 780.

B) Systems installed under NFPA 1221 (2016, 2019) shall have lightning protection that complies with NFPA 780. (NFPA 1221.9.6.3)

- 1) This section of NFPA 1221 clearly states that the Two-Way Radio Communications Enhancement shall be protected by an NFPA 780 compliant Lightning Protection System.
- 2) In buildings where there is an NFPA 780 compliant Lightning Protection System, the BDA System shall be protected by the NFPA 780 compliant Lightning Protection System and the Lightning Protection System shall be re-certified by the Lightning Protection System installer to meet the requirements of NFPA 780.
- 3) In buildings where there is no NFPA 780 compliant Lightning Protection System, a new NFPA 780 Lightning Protection System shall be installed to protect the BDA System. The Lightning Protection System installer shall certify that the installation is per NFPA 780. Coordinate with the AHJ and the installer for the system requirements prior to any work. (The cost of a new NFPA 780 compliant Lightning Protection System could be in excess of \$10,000.00 for a 10,000 SF building.)

C) Lightning Protection Systems are NOT grounding systems.

A Lightning Protection System protects the building structure from a lightning strike. Typically, 3/0 wire is used. A grounding system with surge protection protects the communication system electronics from a lightning strike. Typically, a small #8-#6 awg wire is used.

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Additional Information Attachments (cont.)

3.9 Cables, Raceways, and Pull Boxes

The Manufacturer’s minimum bend radius for repeated bends shall be used for all cables installed in conduits (NFPA 70-110.3B).

The drawing shall specify the conduit sizes and the minimum bend radius of all cables.

Coaxial cables can be easily damaged during the installation. It is recommended that oversized conduits with large radius bends be used to protect the cables during the installation process.

A standard 90-degree elbow for a 2” EMT has a bend radius of 9-1/2”. Some cable spec sheet requires a 10” radius for 1/2” cable with repeated bends. A bend radius of 9-1/2” does not meet the manufacturer’s requirements.

Notes:

1. Riser and donor antenna conduits are recommended to be a minimum of 2” with large 24” radius bends for all riser and donor antenna coaxial cables.
2. Conduits are recommended to be a minimum of 1-1/2” with large 24” radius bends for all feeder coaxial cables (metal raceways).
3. Junction or pull boxes are recommended to be a minimum of 16” x 16” x 4”.
4. The AHJ may require sweep testing at any time. Small conduits, long runs, small junction boxes, or multiple bends could be strong indicators that there might be problems with the installation. Resolutions of these problems are an expensive process and may cause delays on the project.

	90° Elbow	90° Large Elbow
EMT	Bend Radius	Bend Radius
1-1/4”	7.25”	24”
1-1/2”	8.25”	24”
2”	9.5”	24”
Coaxial Cable Plenum Rated 1/2”	Minimum Bend Radius, Repeated Bends	Tensile Strength
RFS 1CA 12-50 JPL	10”	250 lbs.
Trilogy APC 012 J50-RD	5”	275 lbs.
Comscope AL4 RPV-50	5”	175 lbs.

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Additional Information Attachments (cont.)

3.9 Cables, Raceways, and Pull Boxes (cont.)

The Telecommunications Industry Association Standard, TIA/ANSI-569-C, recommends the following guidelines:

9.8.2.1 Length

No section of conduit shall be longer than 100ft. between pull points.

9.8.2.1 Bends

No section of conduit shall contain more than two 90° bends, or equivalent, between pull points.

9.8.2.3 Pull Tension

The pull tension of the cable being installed shall not be exceeded.

9.8.2.4 Pull Boxes

9.8.3.2 Pull Strings

Pull strings shall be placed in installed conduit.

9.9.4 Pathway Fill Factor (Conduits)

For future pathways, the maximum pathway fill shall be 40%.

Required Raceways:

Coaxial cables shall be in metal raceways when required by the pathway survivability.

Coaxial cables shall be in raceways when subjected to possible damage. Coaxial cables are easily damaged when installed exposed or installed above a dropped ceiling. All coaxial cables shall be installed in raceways.

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Additional Information Attachments (cont.)

3.10 Coaxial Cables, Plenum Rated

All coaxial cables inside the building shall be plenum rated.

(NFPA 72-24.3.6.8.1.1) (2013)

(NFPA 1221-9.6.2.1.1.1) (2016)

(NFPA 1221-9.6.2.1) (2019)

To understand this requirement, the NFPA 72 Handbook shall be referenced.

24.5 Two-Way, In-Building Emergency Communications Systems

Two-Way communications service within a building provides a reliable method for fire-fighters and other emergency response personnel to communicate with each other during the course of an emergency. The code recognizes two means: two-way telephones and two-way, in-building radio communications enhancement systems.

24.3.6.8

Two-way radio communications enhancement systems shall comply with 24.3.6.8.1 through 24.3.6.8.4

24.3.6.8.1

Where a two-way radio communications enhancement system is used in lieu of a two-way in-building wired emergency communications system, it shall have a pathway survivability of Level 1, Level 2, or Level 3.

24.3.6.8.1.1

The feeder and riser coaxial cables shall be rated as plenum cables

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Additional Information Attachments (cont.)

3.11 Cables, Pathway Survivability

NFPA 72 (2013)

Riser cables: Installed in a two-hour fire-rated enclosure

Feeder Cables: Pathway Survivability Level 1, 2, or 3

NFPA 72 (2016), NFPA 1221 (2016)

Riser cables: Installed in a fire-rated enclosure
to match building's fire-rating

Feeder Cables: Pathway Survivability Level 1, 2, or 3

NFPA 72 (2019), NFPA 1221 (2019)

Backbone Cables: Installed in a fire-rated enclosure to match building

Antenna Distribution Cables: Not in conduit; Not in a fire-rated enclosure

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Additional Information Attachments (cont.)

3.11 Cables, Pathway Survivability (cont.)

Definitions:

Riser Cable:

There is no definition of a “Riser Cable” found in the NFPA (2013, 2016) Codes. The industry standard is that a “Riser Cable” is a “Backbone Cable”, as defined below:

Examples:

Cable from the donor antenna to the BDA

Cable from the BDA to the distribution antenna cables that are important to the entire building.

Feeder Cable:

There is no definition of a “Feeder Cable” found in the NFPA (2013, 2016) Codes. The industry standard is that a “Feeder Cable” is a “Distribution Antenna Cable”, as defined below.

Examples:

Cable from the BDA to the DAS antennas that are not “Riser Cables”

Cable from the “Riser Cable” to the DAS antennas

NFPA 1221, 2019:

Backbone Cable:

Similar to a “Riser Cable”

NFPA 1221-3.3.10 Backbone. A communication cable in an in-building radio enhancement system that carries wideband signals important to the entire building, from the donor antenna, through the amplifiers, and to distribution antenna lines.

NFPA 1221-a.3.3.10 Backbone. Damage to a backbone cable will disable the radio enhancement system through much or all of the building, and as a result it should be identified and protected. The backbone could be fiber-optic, copper, or coaxial cable, but it does not radiate RF energy along its path.

Distribution Antenna Cable:

Similar to a “Feeder Cable”

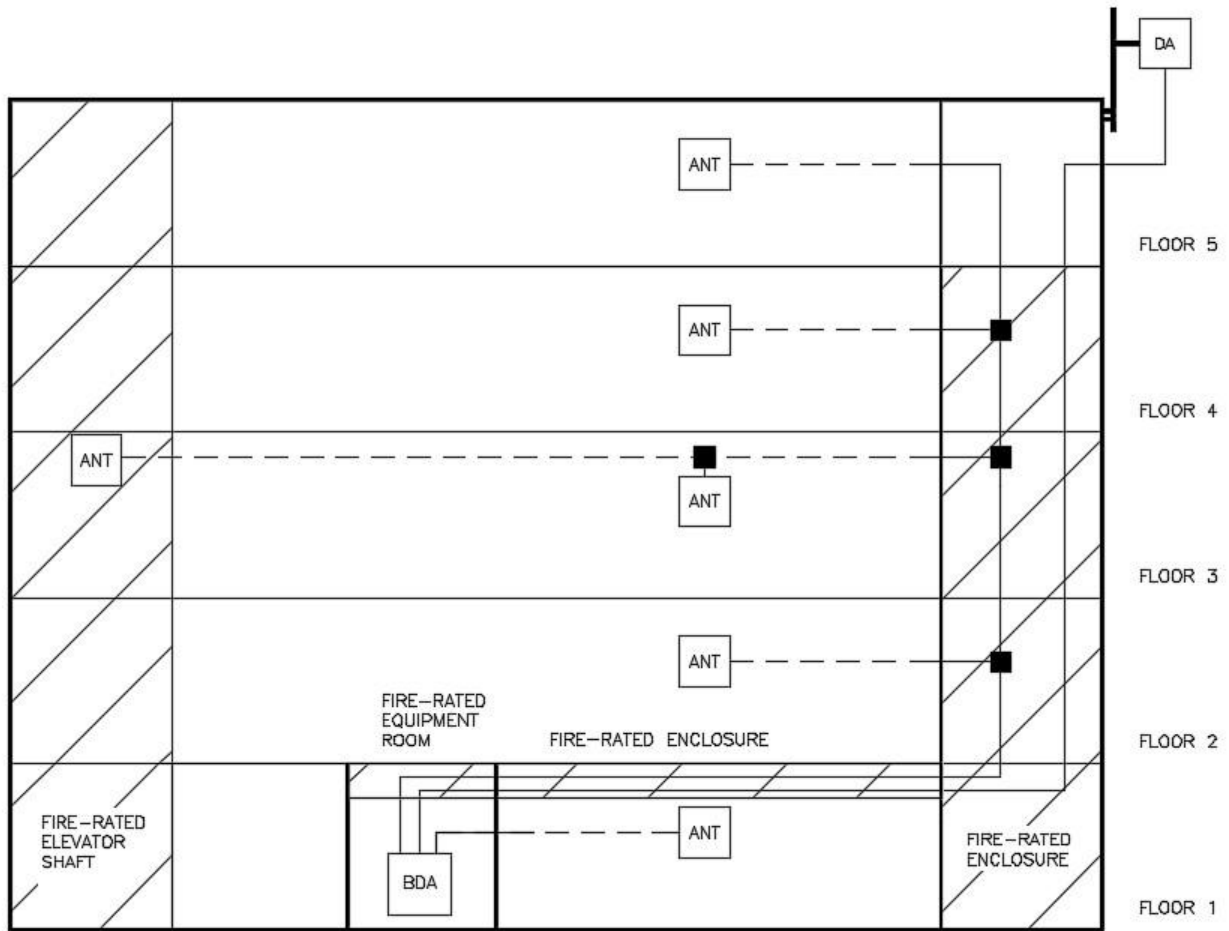
NFPA 1221-3.3.46 Distribution Antenna Cable. A communication cable that carries RF energy in both directions along its length to distribution antennas in one or more places in the building.

NFPA 1221-A.3.3.46 Distribution Antenna Cable. It is typically a coax cable or radiating cable, and it is outside of the heat and fire protection provided by any firewalls or other means.

Additional Information Attachments (cont.)

3.12 Cables, Typical Details

NFPA 72 (2013)



Notes and Legend

Fire-rated enclosures shall have a 2-hour fire-rating

Pathway survivability Levels 1, 2, or 3

All cables shall be plenum rated.

Riser cables (solid):

In a fire-rated enclosure

Feeder cables (dashed)

Level 1: In a fire-rated enclosure or in metal raceways

Level 2,3: In a fire-rated enclosure

Provide fire stop where cables penetrate fire-rated walls or floors.



Donor Antenna



Distribution Antenna



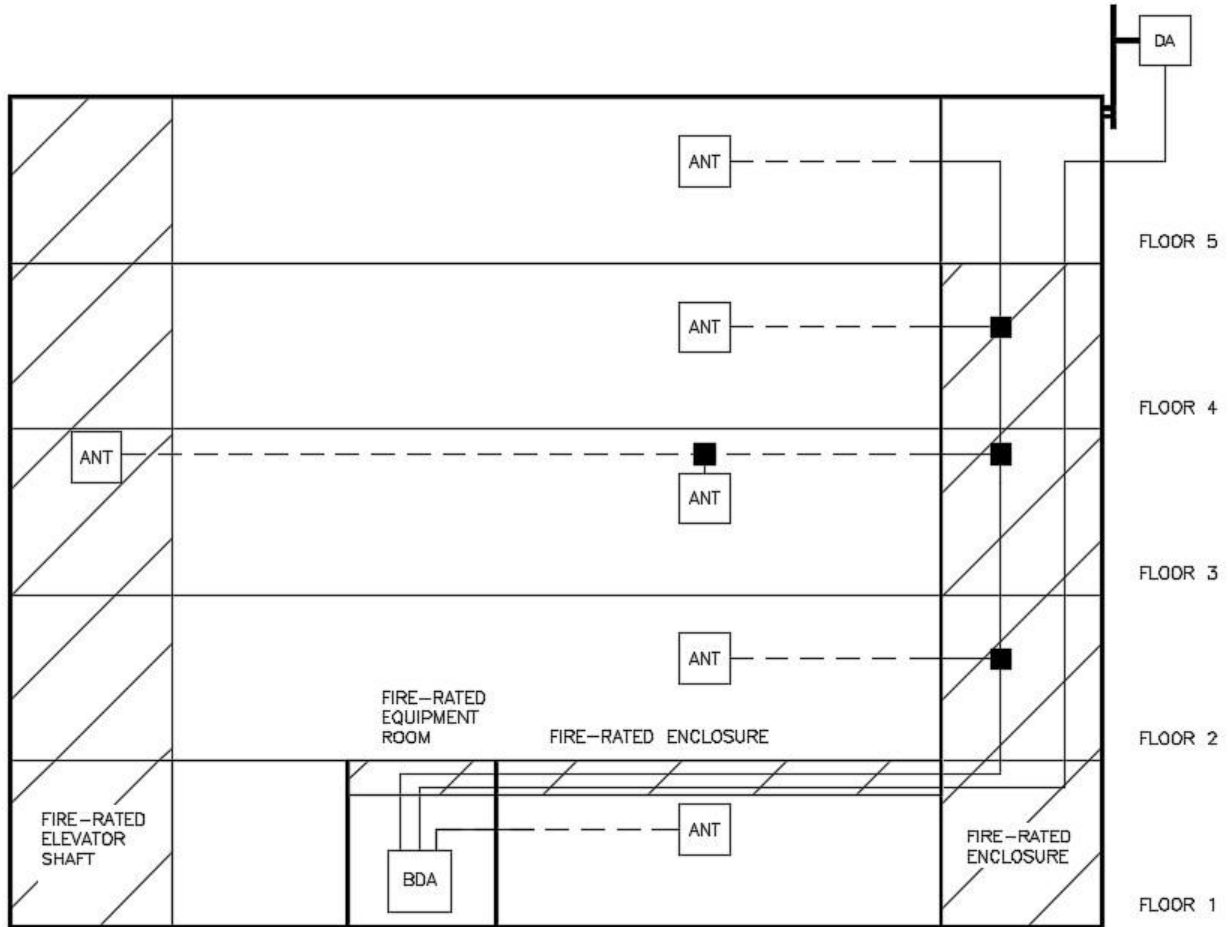
Bi-directional amplifier, Public Safety repeater

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Additional Information Attachments (cont.)

3.13 Cables, Typical Details

NFPA 72 (2016), NFPA 1221 (2016)



Notes and Legend

Fire-rated enclosures shall match the building's fire-rating.

Pathway survivability Levels 1, 2, or 3

All cables shall be plenum rated.

Riser cables (solid):

In a fire-rated enclosure

Feeder cables (dashed)

Level 1: In a fire-rated enclosure or in metal raceways

Level 2,3: In a fire-rated enclosure

Provide fire stop where cables penetrate fire-rated walls or floors.



Donor Antenna



Distribution Antenna



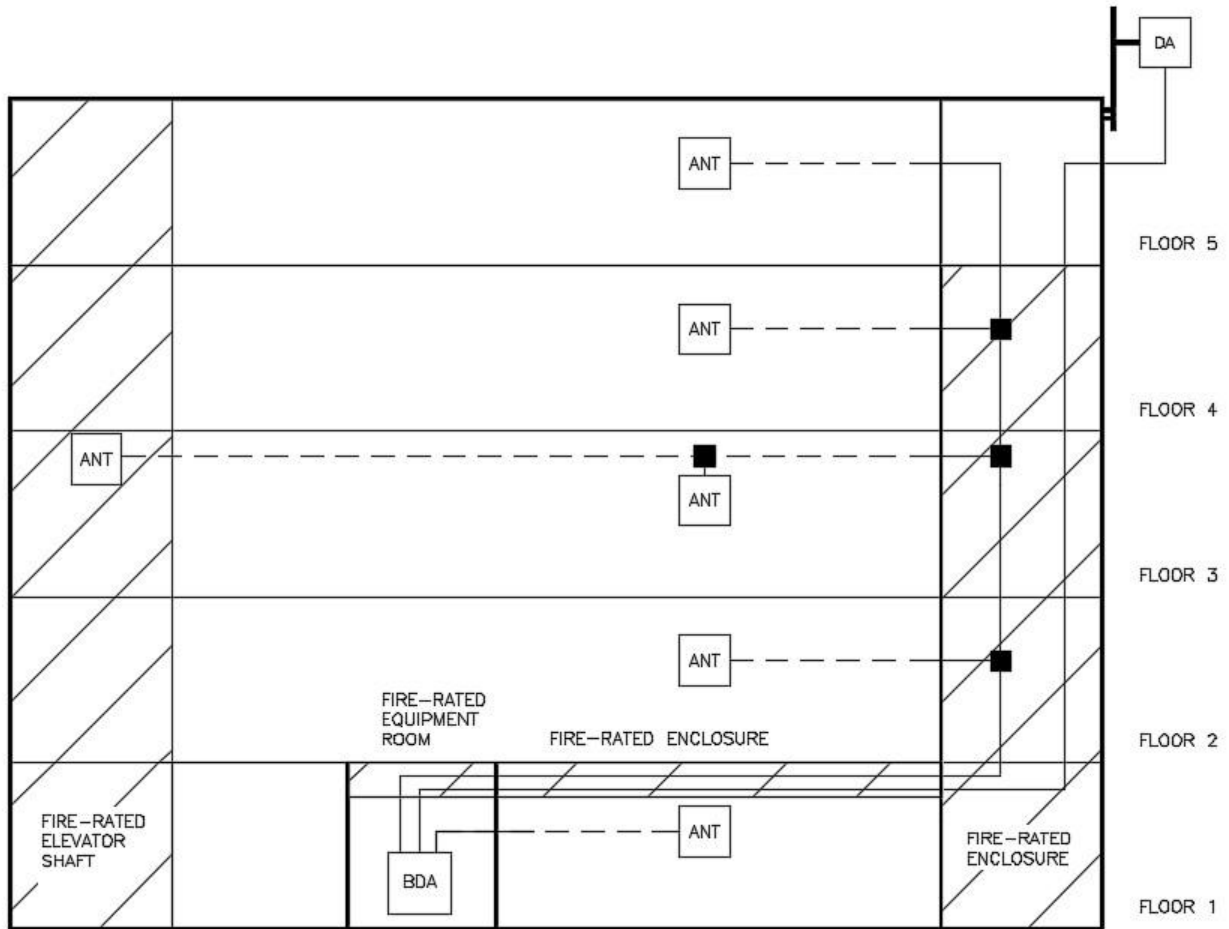
Bi-directional amplifier, Public Safety repeater

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Additional Information Attachments (cont.)

3.14 Cables, Typical Details

NFPA 72 (2019), NFPA 1221 (2019)



Notes and Legend

Fire-rated enclosures shall match the building's fire-rating

There is no pathway survivability.

All cables shall be plenum rated.

Backbone cables (solid):

In a fire-rated enclosure

Antenna Distribution Cables (dashed):

A fire-rated enclosure is not required.

Metal raceways are not required.

Provide fire stop where cables penetrate fire-rated walls or floors.

DA

Donor Antenna

ANT

Distribution Antenna

BDA

Bi-directional amplifier, Public Safety repeater

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Additional Information Attachments (cont.)

3.15 Engineer of Record

1) State of Florida

Florida Statute FS 471 Engineering
Florida Administrative Code FAC 61G15
Degree in Engineering from an accredited university
Pass the Fundamentals of Engineering Exam
Pass the Professional Engineering Exam
5 years' experience as an engineer under a PE

PE designates Professional Engineer.

Florida does not designate a specific discipline. For example: A civil engineer may design roads, bridges, nuclear power plants, and BDA systems. The State of Florida only states that the engineer shall be qualified. The engineer is qualified until proven differently.

FAC Chapter 61G15-30(4) states:

“Engineering Documents: Engineering documents are designs, plans, specifications, drawings, prints, reports, or similar instruments of service in connection with engineering services or creative work that have been prepared and issued by the professional engineer or under his responsible supervision, direction, or control.”

The engineer cannot sign work designed by others unless the engineer was involved during the design process. The engineer cannot sign and seal plans prepared by others with only a quick review. The engineer shall fully understand the signed and sealed drawings.

Engineers typically sign and seal drawings prepared by designers, CADD operators, software specialists, and others who are under the Engineer's responsible supervision.

2) Florida Building Code (FBC)(2017), Broward County Edition, Section 118.1.4 Design

A sealed submittal from an engineer, with training and experience in Electrical Engineering, shall also be required.

As a minimum, this requires a BSEE (Bachelor's Degree in Electrical Engineering). Additional training is also required as Continuing Education. Experience should include at least five (5) years direct experience in Electrical Engineering.

3) NFPA 72 (2013)

Section 10.5.1.4: The system designer shall provide evidence of their qualifications and/or certifications when required by the Authority Having Jurisdiction (AHJ).

Additional Information Attachments (cont.)

3.16 Elevator Cabs

Elevator cabs are used by first responders on a daily basis. NFPA 72-25.5.2.2.1 does not include the elevator cab as a critical area. The elevator cab is included in the general building area. General building areas shall be provided with 90% floor area radio coverage.

This is interpreted as follows:

Each elevator cab shall have a minimum of 90% floor area radio coverage. Sufficient DAS antennas shall be provided in the elevator lobbies and/or in the elevator shafts. Antennas installed in the elevator shafts require a variance from the AHJ.

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Additional Information Attachments (cont.)

3.17 Signal Strength (Design vs. Code)

NFPA 24.5.2.3 requires a minimum signal strength of -96 dBm and a minimum of 15 dB above the signal booster gain.

The only way to pass a final inspection with these values is that a system shall be designed with a -90 dBm and a minimum of 20 dB above the signal booster gain.

NFPA 1221-9.3.1.2.2 (2016) requires a minimum DAQ of 3.0. However, the annex A9.3.1.2.2 recommends that the system be designed for DAQ of 3.4.

The design value shall always be more stringent than the code value.

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Additional Information Attachments (cont.)

3.18 FCC Signal Booster Registration

Year	Broward	Miami-Dade	Palm Beach	Totals
2015	6	9	1	16
2016	22	48	2	72
2017	46	61	2	109
2018	93	65	6	164
2019	77	78	8	163
Total	244	261	19	524

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Additional Information Attachments (cont.)

3.19 Reserved

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Additional Information Attachments (cont.)

3.20 Reserved

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Additional Information Attachments (cont.)

3.21 Reserved

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