



## Radio Antenna Systems for First Responders

The emergency radio communications systems used by public safety first responders are key to the successful resolution of emergency incidents. Modern practices require that constant connectivity with support teams is available to ensure a successful outcome of an incident, as well as the safety of the first responders. Buildings of non-combustible construction or buildings that have glazing with low emissivity rating can cause interference with radio signals. City of Vancouver Fire and Rescue Services has undertaken consultation with stakeholders and the industry and codified the installation of the in-building antenna systems in the 2019 Vancouver Building By-Law (VBBL).

As Vancouver Fire and Rescue Services also provides emergency response and firefighting for UBC, the same level of radio communication performance is to be provided for UBC buildings. The requirement for in-build radio antenna systems are currently not in the 2018 BC Building Code, which is applicable to UBC. Thus, Bulletin 20-1 outlines the adoption of the following VBBL requirements for new and renewal projects:

- Article 3.2.5.20 Radio Antenna Systems and Appendix A-3.2.5.20
- Sentences VBBL 3.2.4.9.(5) and (6) for electrical supervision

A fire separation that separates an exit from the remainder of the building may have wires, cables, totally enclosed noncombustible raceways, and distributed antenna for a radio antenna system conforming to Sentence 3.2.5.20.(1) of VBBL.

Where a specialty engineer is to be engaged in the design of the in-building antenna system, the registered professional of record for electrical is required to provide the performance specification in the electrical plans for the building permit application. Detailed plans containing the design information outlined in paragraph 3 of Appendix A-3.2.5.20 of VBBL can be in the form of a shop drawing. Schedule S letters between the registered professionals for electrical are appropriate.

The referenced VBBL requirements are reproduced for convenience.

### 3.2.5.20. Radio Antenna Systems

- 1) Except as permitted by Sentence (2), an acceptable radio antenna system shall be installed in every building that
  - a) is more than 6 storeys in building height,
  - b) contains more than 1 storey in the basement, or
  - c) contains more than 1200 m<sup>2</sup> of floor area in the basement.
- 2) A radio antenna system shall not be required for
  - a) government buildings requiring security against transfer of signals inside and outside of buildings, and
  - b) where, in the opinion of the Chief Building Official, in consultation with the Fire Chief, radio signals compromise the intended use of the building.
- 3) A radio antenna system shall provide not less than 98% coverage at in each of the following critical locations in the building
  - a) exit stair shafts,
  - b) exit corridors,
  - c) public corridors,
  - d) corridors used by the public,
  - e) corridors serving classrooms or patients' sleeping rooms,
  - f) within 5 m of the fire alarm control unit,
  - g) within 5 m of the central alarm and control facility,
  - h) within 5 m of the fire alarm annunciator,
  - i) fire pump room,
  - j) emergency generator room,
  - k) electrical service and transformer room,
  - l) elevator machine room,
  - m) elevator lobbies,
  - n) elevator hoistways,
  - o) corridors in the basement and not within a suite, and
  - p) storage garages and associated vehicle ramps.

### 3.2.4.9. Electrical Supervision

- 1) Electrical supervision shall be provided for a fire alarm system.
- 2) If a fire alarm system in a building is required to have an annunciator by Sentence 3.2.4.8.(1), except for hose valves, all valves controlling water supplies in a standpipe system shall be equipped with an electrically supervised switch for transmitting a trouble signal to the annunciator in the event of movement of the valve handle.



- 3) An automatic sprinkler system shall be electrically supervised to indicate a trouble supervisory signal on the building fire alarm system annunciator for each of the following:
  - a) movement of a valve handle that controls the supply of water to sprinklers,
  - b) loss of excess water pressure required to prevent false alarms in a wet pipe system,
  - c) loss of air pressure in a dry pipe system,
  - d) loss of air pressure in a pressure tank,
  - e) a significant change in water level in any water storage container used for firefighting purposes,
  - f) loss of power to any automatically starting fire pump (See Note A-3.2.4.9.(3)(f).), and
  - g) a temperature approaching the freezing point in any dry pipe valve enclosure or water storage container used for firefighting purposes.
  
- 4) A fire pump shall be electrically supervised as stipulated in NFPA 20, "Installation of Stationary Pumps for Fire Protection."
  
- 5) Except as permitted by Sentence (6), a radio antenna system shall perform a self-test at least twice daily and shall be electrically supervised to indicate a trouble signal on the building fire alarm system annunciator for:
  - a) loss of power to any head-end equipment, and
  - b) fundamental failure of a self-test.
  
- 6) Electrical supervision of a radio antenna system in a building in which a fire alarm system is not installed shall be provided by an acceptable method.

A-3.2.5.20. Radio Antenna System. Buildings of noncombustible construction or buildings that have glazing with a low emissivity rating can cause interference with radio signals that are necessary for emergency, firefighting and rescue operations. The installation of a radio antenna system should be shown on drawings submitted for building permit, and related permits. A complete design of the radio antenna system will be required on plans to be submitted for the building permit, and should be design in accordance with the general specification provided by Vancouver Fire and Rescue Services. See Fire Department publication "Vancouver Fire Rescue Services Specifications for Radio Antenna System Design, Installation and Acceptance Testing" as updated from time to time. By-law users are advised to keep up-to-date. The technical specifications as of May 2019 are reproduced here for convenience.

## Specifications for Radio Antenna System - Design, Installation and Acceptance Testing (May 2019)

### 1. SCOPE

1.1. This Specification describes the requirements for the design, installation, and acceptance testing of a radio antenna system in a building.

1.2. The installation of radio antenna system equipment and devices not covered by this Specification shall be in accordance with good engineering practice and the manufacturer's installation instructions.

1.3. The work in this section shall be performed under the supervision of a registered professional engineer in British Columbia

### 2. REQUIREMENTS OF RADIO ANTENNA SYSTEMS

#### 2.1. GENERAL

2.1.1. Radio antenna systems for emergency responders are an integral component of the life safety equipment of a building or structure. The primary function is to provide reliable emergency responder communications at the required signal strength within the specified areas.

2.1.2. Provide an in-building radio antenna system to provide coverage in the building for the public safety agencies as required by the local fire department and other agencies and authorities having jurisdiction. System users shall receive and transmit radio broadcasts from their portable radio units within the building. This shall be accomplished utilizing the following components, which if applicable shall conform to UL 2524 "Standard for In-building 2-Way Emergency Radio Communication Enhancement Systems":

- a) Bi Directional Amplifiers (Signal Boosters)
- b) Coaxial Cable
- c) Frequency filters
- d) Donor and discrete antennas
- e) Other components and interconnecting circuitry as required

2.1.3. Radio antenna systems shall not rely on mobile repeaters installed on fire department apparatus.

2.1.4. The entire system shall meet with approval of the Fire Chief, Chief Building Official, and Director of Planning for UBC (the authorities having jurisdiction, AHJ).

2.1.5. All permits necessary for the installation of the work shall be obtained from the AHJ prior to the commencement of the work.

All permit costs and inspection fees shall be included as the part of the required work.

#### 2.2. FEDERAL LICENSE

2.2.1. All active systems shall be licensed by the federal regulator, Innovation, Science & Economic Development Canada (ISED),



2.2.2. The installing contractor shall arrange to obtain the federal license to operate on behalf of the owner.

2.2.3. The installing contractor shall be responsible for any fees and costs to obtain the federal license for the first year of operation.

2.2.4. Any license required shall be renewed annually by the building owner and the cost of the licensing borne solely by the building owner.

### **3. PLANS AND SUPPORTING DOCUMENTS**

3.1. The plans and supporting documents for the radio antenna system shall include a complete and detailed description of the following:

- a) Installation instructions
- b) Location of in-building antenna
- c) Location of donor antenna
- d) Location of riser and trunk on each floor
- e) Location of amplifier, repeater, and head-end equipment
- f) Connection to the fire alarm system for a common trouble zone
- g) Critical locations requiring coverage
- h) Method of Acceptance Testing

### **4. INSTALLATION OF RADIO ANTENNA EQUIPMENT**

#### **4.1. AMPLIFIERS, REPEATERS AND HEAD-END EQUIPMENT**

4.1.1. Amplifiers, repeaters, and head-end equipment shall be located in a service room that is provided with not less than 1 h fire-resistance rating.

4.1.2. All amplifiers, repeaters, and head-end equipment required by the radio antenna system shall be protected by enclosures rated CSA Type 3 or higher.

4.1.3. All amplifiers, repeaters and head-end equipment shall be provided with drip shield to guard against water spray from fire sprinklers located in the room unless the enclosures are rated CSA Type 4 or higher.

#### **4.2. DISTRIBUTED ANTENNA SYSTEM**

4.2.1. One in-building antenna shall be located within 20 m of the elevator door opening at each odd-numbered storey.

4.2.2. One in-building antenna shall be located inside each exit stair shaft at the landing of each even numbered storey.

4.2.3. Additional in-building antennas shall be installed to provide 98 percent radio coverage inside each critical area as described in the Vancouver Building By-law.

4.2.4. Sufficient antenna isolation shall be maintained between the donor antenna and all in-building antenna (D.A.S.) under all operating conditions.

#### 4.3. WIRING

4.3.1. Cables and wires shall be FT-4 rated, and where installed inside plenums, cables and wires shall be FT-6 rated.

4.3.2. Except within service rooms containing the amplifiers, repeaters and head-end equipment, cables and wires installed in the risers shall be mechanically protected per the Electrical Code.

#### 4.4. INTERCONNECTION TO THE FIRE ALARM SYSTEM

4.4.1. The radio antenna system shall be monitored by the building fire alarm system for common trouble

#### 4.5. PROVISION FOR RADIO ANTENNA SYSTEM EXPANSION

4.5.1. Raceways shall be installed to allow installation of future in-building antenna in the floor area of each storey not already provided with wiring or horizontal distribution.

### 5. ACCEPTANCE TESTING

#### 5.1. Adequate Radio Coverage

5.1.1. The intent is to achieve -95 dBm on the current public safety bands. Good design should provide a margin of not less than 10 dB to allow for uncontrolled variables. Based on the foregoing, the design target for indoor coverage should be -85 dBm.

5.1.2. The radio frequency range to be supported shall be any frequencies used by the public safety communications service provider's network. If signal amplifiers are used, they shall include filters that will protect the amplifiers from overload and the system from interference by out-of-band signals.

5.1.3. In the event that active amplification is required to meet the foregoing communication quality requirements in the building, coordination with the public safety communications service provider is required to ensure that its outdoor radio communication performance is not degraded. If there is a trade-off to be made between maintaining the public safety communications service provider's outdoor radio communication performance and restoration of signal strength in the building, the trade-off decision shall be made by the public safety communications service provider and communicated to the Fire Chief by the building owner.

#### 5.2. System Verification Procedures

5.2.1. Tests shall be performed by RF technicians under supervision of a professional engineer registered in the Province of British Columbia. Test reports shall bear the seal of the engineer.

5.2.2. If required by the engineer, during the engineer's acceptance test, portable handheld radios used for speech and coverage acceptance shall be the same type used by Vancouver Fire and Rescue Services.

5.2.3. Acceptance tests and measurements shall be performed after completion of installation of the Radio Antenna System. Tests shall be performed using



radio frequencies assigned by the public safety communications service provider, after proper coordination with an authorized representative of that system and with the Fire Chief.

5.2.4. Where the floor area of a critical location is greater than 4,500 m<sup>2</sup> the area shall be divided into a uniform grid of not more than 15 m on a side, or if the floor area is smaller than 4,500 m<sup>2</sup> it shall be divided into a uniform grid of approximately 20 equal areas, to a minimum of 9 m<sup>2</sup>, and measurements shall be taken in each grid area. The size of the grids shall also be reduced, or the number of grids increased, upon recommendation of the Fire Chief or inspector in areas where special construction or other obstruction may significantly affect communications.

5.2.5. If the Radio Antenna System fails to provide acceptable communication in any of the critical locations as stipulated in the Building By-law, the building owner shall have the system rectified to meet the 98% coverage requirement for these areas; otherwise the Radio Antenna System will not be accepted.

### 5.3. Tests for Optimization

5.3.1. The radio antenna system shall be optimized to provide maximum coverage of the remainder of the floor areas while providing 98 % coverage in the critical locations.

### 5.4. Tests of Power Supply

5.4.1. Backup batteries and power supplies shall be tested under full load using a minimum of a 90% duty cycle for a period of at least one hour. If within the one-hour period, the battery shows no symptom of failure or impending failure, the test shall be continued for additional one-hour periods to determine the integrity of the battery. The battery shall not fail within a four-hour continuous test period.

5.4.2. Alternatively, the power supply may be connected to the building emergency generator with the backup batteries to supply a four-hour continuous power supply.

## 6. DOCUMENTATION

### 6.1. DOCUMENTATION REQUIRED

6.1.1. The documentation required by this section shall be maintained on site in a box located in a location acceptable to the Fire Chief.

6.1.2. Documentation for the radio antenna system shall include the following description of the radio antenna system:

- a) Instructions for resetting the system
- b) Equipment operating instructions or manuals
- c) Equipment maintenance instructions
- d) Equipment testing instructions

- e) Optimization tests
- f) Signal strength tests at critical locations
- g) Results of battery test
- h) Results of testing of connection to the fire alarm system

6.1.3. The designer of the radio antenna system shall prepare the Health SC6 report which certifies the system meets Safety Code

6.1.4. After installation of the radio antenna system is completed, the designer shall provide confirmation that the radio antenna system meets Safety Code 6.

6.1.5. A copy of the annual operating license issued by Federal communications agency shall be included in the fire safety plan for the building.



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