



SANTA CLARA FIRE DEPARTMENT

FIRE PREVENTION & HAZARDOUS MATERIALS DIVISION

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EMERGENCY RESPONDER RADIO COVERAGE SYSTEMS

510.1 Emergency responder radio coverage in new buildings. Approved radio coverage for emergency responders shall be provided within all buildings meeting any one of the following conditions:

1. There are more than 3 stories above grade plane (as defined by the Building Code Section 202);
2. The total building area is 30,000 square feet or more;
3. The total basement area is 5,000 square feet or more;
4. Where required by the fire code official and radio coverage signal strength levels are not consistent with the minimum levels set forth in Section 510.4.1

Exceptions:

1. Where it is determined by the fire code official that the radio coverage system is not needed.
2. In facilities where emergency responder radio coverage is required and such systems, components or equipment required could have a negative impact on the normal operations of that facility, the fire code official shall have the authority to accept an automatically activated emergency responder radio coverage system.
3. Buildings and areas of buildings that have minimum radio coverage signal strength levels of the Silicon Valley Regional Interoperability Authority (SVRIA) P25 Phase 2 700 MHz Digital Trunked Radio System within the building in accordance with Section 510.4.1.

The radio coverage system shall be installed and maintained in accordance with Sections 510.4 through 510.7 of this code and with the applicable provisions of NFPA 1221, Standard for the Installation, Maintenance and Use of Emergency Services Communications Systems.

The coverage shall be based upon the existing coverage levels of the public safety communication systems at the exterior of the building. This section shall not require improvement of the existing public safety communication systems.

510.1.1 Obstruction by new buildings. No obstruction of the public safety system backhaul shall be allowed without an approved mitigating plan.

510.2 Emergency responder radio coverage in existing buildings. Existing buildings shall be provided with approved radio coverage for emergency responders as required in Chapter 11.

510.3 Permit required. A construction permit for the installation of or modification to emergency responder radio coverage systems and related equipment is required as specified in Section 105.7.5. Maintenance performed in accordance with this code is not considered a modification and does not require a permit.

An operational fire permit may be required to maintain an emergency responder radio coverage system.

510.3.1 SVRIA system registration. Prior to issuance of a construction permit, systems must be registered with the SVRIA and proof of registration shall be submitted upon plan submittal.

510.3.2 Plan Submittal Documents

1. A minimum of two (2) copies of the plan, wet-signed by the architect or engineer of record shall be submitted. The minimum plan size for this type of submittal is 24-inches by 36-inches (1/8" scale minimum).
2. A minimum of two (2) material data packages (in separate binders) shall accompany the plans, and include all designer and installer documentation. Material data packages shall include all manufacturers' specification sheets for all devices, equipment, and materials to be used shall be submitted, including the transponder to the supervising station. Highlight on the cut sheet which device or equipment is being used, the listing information, and the application per listing, as well as, manufacturer's installation instructions.
3. Shop drawings shall be of sufficient clarity and detail to fully describe the proposed installation and equipment. Shop drawings shall include, but are not limited to the following:
 - a. Title Sheet;
 - b. Vicinity and site maps;
 - c. Equipment legend;
 - d. Scaled architectural floor plans (1/8" minimum);
 - e. Rooms and areas labeled;
 - f. Location of the amplifiers modules, relays, and all other associated equipment;
 - g. Size, type, and protection method of cable to be utilized;
 - h. Single-line riser diagram of system of entire system, including interconnection fire alarm control panel. The riser diagram shall show any shared arrays;
 - i. Design calculations for signal levels at each terminal point and initial input signal strength;
 - j. Signal propagation map (color map indicating the signal strengths as designed);
 - k. Secondary power calculations.
 - l. UL listed through penetration fire-stop assemblies as specified by the Architect of Record.
 - m. Copy and paste this ERRCS guideline (all pages) onto the drawings.

510.4 Technical requirements. Systems, components, and equipment required to provide emergency responder radio coverage systems shall comply with Section 510.4.1 through 510.4.2.5.

510.4.1 Radio signal strength. The building shall be considered to have acceptable emergency responder radio coverage when signal strength measurements in 90-percent of all areas on each floor of the building meet the signal strength requirements in Sections 510.4.1.1 and 510.4.1.2.

Exception: Critical areas, such as the fire command center(s), the fire pump room(s), interior exit stairways, exit passageways, elevator lobbies, standpipe cabinets, sprinkler valve locations, and other areas required by the fire code official, shall be provided with 99 percent floor area radio coverage.

510.4.1.2 Minimum signal strength into the building. A minimum signal strength of -95 dBm shall be receivable in 90% of the area of each floor within the building when transmitted from the Silicon Valley Regional Interoperability Authority (SVRIA) P25 Phase 2 700 MHz Digital Trunked Radio System.

510.4.1.3 Maximum signal strength out of the building. A maximum signal strength of -95 dBm shall be received by the Silicon Valley Regional Interoperability Authority (SVRIA) P25 Phase 2 700 MHz Digital Trunked Radio System at the donor site when transmitted from 90% of the area of each floor within the building.

510.4.1.3 Signal strength differential. The system shall be designed to ensure that there is a minimum 15 dBm difference between the interior and exterior signal strength.

510.4.1.4 Delivered audio quality. The radio coverage system shall provide a minimum delivered audio quality of level 3.4 (DAQ “3.4”) on each floor of the building or structure. DAQ 3.4 constitutes audio quality that makes speech understandable with repetition only rarely required with some noise and distortion.

510.4.1.5 Building raceway and pathway survivability. Riser and antenna cable/fiber shall be installed within a vertical rated enclosure having a fire resistive rating of not less than 2-hours. The 2-hour vertical enclosure shall be installed in an approved location on the lowest floor level and extend to the roof. Fire rated access panels (90 minutes) shall be provided along the rated enclosure at the splitter locations and/or other critical areas for maintenance. All cable is required to be plenum-rated. Also, a minimum two-inch size conduit is required to be provided inside the shaft (**see Figure #2 on Page 10**).

Exception: In existing buildings, riser cable mechanically protected by metal conduit can be routed through a sprinkler-protected, 1-hour rated enclosure, including the door.

Cable other than radio cable is allowed to comingle with the radio cable in conduit provided it is listed, shielded cable that will not interfere with the radio cable, and fill capacity outline in the California Electrical Code is not exceeded.

Equipment Survivability. For new building rooms housing ERRC equipment shall be in located in the fire alarm command center or next to the FACP separated from the remainder of the building by 2 hour rated fire barriers. For existing buildings, the location of the ERRC equipment shall be pre-approved by the Plan Review Office.

510.4.2 System design. The emergency responder radio coverage system shall be designed in accordance with Sections 510.4.2.1 through 510.4.2.5.

510.4.2.1 Amplification systems allowed. Buildings and structures that cannot support the required level of radio coverage shall be equipped with a radiating cable system, a distributed antenna system with Federal Communications Commission (FCC)-certified, Class A channelized (spectrum agile) public safety grade signal boosters (amplifiers) designed for the frequencies specified by the fire code official, in order to achieve the required adequate radio coverage.

510.4.2.2 Technical criteria. Frequencies required, location of radio sites, and other supporting technical information is noted below:

Santa Clara Fire Department 700 MHz Frequencies		
West Cell		
Channel	Transmit (TX)	Receive (RX)
1	772.45625	802.45625
2	772.30625	802.30625
3	772.15625	802.15625
4	771.85625	801.85625
5	771.40625	801.40625
6	770.08125	800.08125
7	774.68125	804.68125
8	774.40625	804.40625
9	773.93125	803.93125
10	773.18125	803.18125
11	772.90625	802.90625
12	772.60625	802.60625
13	<i>SPARE</i>	<i>SPARE</i>
14	<i>SPARE</i>	<i>SPARE</i>
15	<i>SPARE</i>	<i>SPARE</i>
16	<i>SPARE</i>	<i>SPARE</i>
17	<i>SPARE</i>	<i>SPARE</i>
18	<i>SPARE</i>	<i>SPARE</i>
19	<i>SPARE</i>	<i>SPARE</i>
20	<i>SPARE</i>	<i>SPARE</i>
21	<i>SPARE</i>	<i>SPARE</i>
22	<i>SPARE</i>	<i>SPARE</i>
23	<i>SPARE</i>	<i>SPARE</i>
24	<i>SPARE</i>	<i>SPARE</i>
Additional Information:		
1. Control Channel (Channel 2)		

Donor Site Coordinates
City of Santa Clara
City of Sunnyvale
City of Mountain View
County Communication Center (Carol Drive)
Pruneyard Communications Facility

510.4.2.2.1. The Public Safety radio system, extending from the head-end amplifier to the distributed antennas shall not be combined with other DAS systems installed in the building.

510.4.2.2.2. A single antenna system is allowed provided the antennas are capable of passively distributing all frequencies between 698MHz and 2.7GHz and the hardware for both Public Safety and

wireless carrier frequencies are completely separate with necessary filters. The single antenna system must also be tested and certified by a qualified contractor.

510.4.2.2.3. Where fiber distribution systems are used to extend the Public Safety radio system throughout the building or to other buildings, the horizontal fiber runs shall be enclosed in conduit meeting at least the building conduit requirements in Section 510.4.1.5.

510.4.2.3 Power supply sources. Emergency responder radio coverage systems shall be provided with at least two independent and reliable power supply sources conforming to NFPA 72 and the Electrical Code, one primary and one secondary. The standby power supply shall be an approved UPS system capable of operating the emergency responder radio coverage system for duration of not less than 24 hours. When primary power is lost, the power supply to the emergency responder radio coverage system shall automatically transfer to the standby power supply.

510.4.2.3.1 Emergency power off (EPO). The UPS system shall be equipped with an emergency power off (EPO) switch in a location approved by the fire code official (next to the main FACP). The EPO shall disconnect both the circuit breaker and secondary power supply simultaneously.

510.4.2.4 Signal booster requirements. If used, signal boosters shall meet the following requirements:

1. All signal booster components shall be contained in a National Electrical Manufacturer's Association (NEMA) 4-type waterproof cabinet.
2. Battery systems used for the emergency power source shall be contained in a NEMA 4-type waterproof cabinet.
3. The signal booster system and power supply(ies) shall be electrically supervised and monitored in accordance with NFPA 1221. For buildings without a fire alarm system, a dedicated monitoring panel in accordance with NFPA 72 shall be provided to annunciate automatic supervisory and trouble signals for the signal booster system and power supply(ies) and sound an audible signal at a constantly attended location.
4. Equipment shall have FCC certification prior to installation.

System Monitoring (NFPA 1221, 9.6.13). The system shall include automatic supervisory signal for malfunction of the two-way radio communications enhancement system that are annunciated by the fire alarm system in accordance with NFPA 72 and shall comply with the following:

1. Monitoring for integrity of the system shall comply with NFPA 72, Chapter 10.
2. System supervisory signals shall include the following:
 - (a) Donor antenna malfunction
 - (b) Active RF emitting device failure
 - (c) Low-battery capacity indication when 70 percent of the 24-hour UPS operating capacity has been depleted
 - (d) System component failure (all components to include antenna, cable, etc.).
3. Power supply supervisory signals shall include the following for each RF emitting device and system component:
 - (a) Loss of normal ac power
 - (b) Failure of battery charger

4. The communications link between the fire alarm system and the two-way radio communications enhancement system must be monitored for integrity.

Dedicated Panel (NFPA 1221, 9.6.13.2).

1. A dedicated monitoring panel (located on the wall) shall be provided within the fire command center (or FACP Room) to annunciate the status of all RF emitting devices and system component locations. The monitoring panel shall provide visual and labeled indications of the following for each system component and RF emitting device:
 - (a) Normal ac power
 - (b) Loss of normal ac power
 - (c) Battery charger failure
 - (d) Low battery capacity (to 70 percent depletion of the 24-hour UPS back-up)
 - (e) Donor antenna malfunction
 - (f) Active RF emitting device malfunction
 - (g) System component malfunction (all components to include antenna, cable, etc.).
2. The communications link between the dedicated monitoring panel and the two-way radio communications enhancement system must be monitored for integrity.

510.4.2.5 Additional frequencies and change of frequencies. The emergency responder radio coverage system shall be capable of modification or expansion in the event frequency changes are required by the FCC or additional frequencies are made available by the FCC.

510.5 Installation requirements. The installation of the public safety radio coverage system shall be in accordance with Sections 510.5.1 through 510.5.6.

510.5.1 Approval prior to installation. Amplification systems capable of operating on frequencies licensed to any public safety agency by the FCC shall not be installed without prior coordination and approval of the fire code official.

510.5.2 Minimum qualifications of personnel. The minimum qualifications of the system designer, lead installation personnel and personnel conducting radio system testing shall include possession of both of the following:

1. A valid FCC-issued general radio operators license; and
2. Certification of in-building system training issued by one of the following:
 - a. Associated Public Safety Communications Officials (APCO),
 - b. National Association of Business Education Radio (NABER),
 - c. Personal Communications Industry Association (PCIA) or,
 - d. Manufacturer of the equipment being installed.

All design documents and all tests shall be documented and signed by a person meeting the minimum qualification noted in this section.

510.5.3 Acceptance test procedure and system certification. Upon completion of installation, the building owner shall have the radio system tested to verify that two-way coverage on each floor of the building is in accordance with Section 510.4.1. The test procedure shall be conducted as follows:

1. Talk-back testing from a site to the Silicon Valley Regional Interoperability Authority (SVRIA) P25 Phase 2 700 MHz Digital Trunked Radio System shall use Santa Clara Fire Department radio(s) on the designated control channel (Channel 2). Testing may be required to be witnessed by a representative of the Santa Clara Fire Department. Radios for texting can be obtained by contacting the City of Santa Clara, Radio Shop at 408-615-5593.
2. Each floor of the building shall be divided into a grid of 20 approximately equal test areas.
3. The test shall be conducted using a calibrated portable radio of the latest brand and model used by the agency talking through the agency's radio communications system.
4. In the event that three of the test areas on a floor fail the talk back test, in order to be more statistically accurate, the floor shall be permitted to be divided into 40 equal test areas. If the system fails the 90% coverage requirement for the 40-area test, the emergency responder radio system shall be altered to meet the 90-percent coverage requirement.

Exception: Critical areas, such as the fire command center(s), the fire pump room(s), interior exit stairways, exit passageways, elevator lobbies, standpipe cabinets, sprinkler valve locations, and other areas required by the fire code official, shall be provided with 99 percent floor area radio coverage.

5. A test location approximately in the center of each test area shall be selected for the test, with the radio enabled to verify two-way communications to and from the outside of the building through the Silicon Valley Regional Interoperability Authority (SVRIA) P25 Phase 2 700 MHz Digital Trunked Radio System. Once the test location has been selected that location shall represent the entire test area. Failure in the selected test location shall be considered failure of that test area.
6. The test for emergency responder radio coverage will be considered passed when 90% of the test locations on each floor are able to pass two-way communications to and from the outside of the building.

Exception: Critical areas, such as the fire command center(s), the fire pump room(s), interior exit stairways, exit passageways, elevator lobbies, standpipe cabinets, sprinkler valve locations, and other areas required by the fire code official, shall be provided with 99 percent floor area radio coverage.

7. The gain values/output levels of all amplifiers shall be measured and the test measurement results shall be kept on file with the building owner so that the measurements can be verified during annual tests. In the event that the measurement results become lost, the building owner shall be required to rerun the acceptance test to reestablish the gain values.
8. As part of the installation a spectrum analyzer or other suitable test equipment shall be utilized to ensure spurious oscillations are not being generated by the subject signal booster. This test shall be conducted at time of installation and subsequent annual inspections.
9. Individuals conducting initial benchmark and system acceptance tests shall meet the minimum qualifications in accordance with Section 510.5.2.

10. All test results are required to be validated by an approved third party, independent of the system designer and installer.

Prior to issuance of the building Certificate of Occupancy, a system acceptance test report shall be submitted to the fire code official, maintained on the premises and be made available to the public safety department upon request. The report shall verify compliance with Section 510.5.4, and include the emergency responder radio coverage system equipment data sheets, diagram showing device locations and wiring schematic, and a copy of the electrical permit and system certification letter.

510.5.4 FCC Compliance. The emergency responder radio coverage system installation and components shall also comply with all applicable federal regulations, including, but not limited to, FCC 47 CFR Part 90.219.

510.5.5 Location of equipment. For buildings without a fire command center the communications control equipment shall be located inside the building near the fire alarm control panel, or other approved location.

510.5.6 Signage. Buildings equipped with an emergency responder radio coverage system shall be identified by an approved sign located above or near the building key box stating: “Radio System Installed” (see **Figure #1 on Page 9**).

510.6 Maintenance. The emergency responder radio coverage system shall be maintained operational at all times in accordance with Sections 510.6.1 through 510.6.5.

510.6.1 Testing and proof of compliance. The emergency responder radio coverage system shall be inspected and tested annually or whenever structural changes occur including additions or remodels that could materially change the original field performance tests. Individuals conducting the tests shall meet the minimum qualifications in accordance with Section 510.5.2 and shall be an approved third party, independent of the system designer and installer. Testing shall consist of the following:

1. In-building coverage test as described in Section 510.5.3.
2. Signal boosters shall be tested to verify that the gain/output level is the same as it was upon initial installation and acceptance.
3. Backup batteries and power supplies shall be tested under load of a period of 1 hour to verify that they will properly operate during an actual power outage. If within the 1-hour test period the battery exhibits symptoms of failure, the test shall be extended for additional 1-hour periods until the integrity of the battery can be determined.
4. All other active components shall be checked to verify operation within the manufacturer’s specifications.
5. At the conclusion of the testing, a report, which shall verify compliance with Sections 510.5.3 and 510.6 shall be submitted to the fire code official and a copy maintained on the premises and made available upon request.

510.6.2 Additional frequencies. The building *owner* shall modify or expand the emergency responder radio coverage system at their expense in the event frequency changes are required by the FCC or additional

frequencies are made available by the FCC. Prior approval of a public safety radio coverage system on previous frequencies does not exempt this section.

510.6.3 Field testing. Agency personnel shall have the right to enter onto the property at any reasonable time to conduct field testing to verify the required level of radio coverage.

510.6.4 Qualifications of testing personnel. All tests shall be documented and signed by a person meeting the minimum qualifications set forth in Section 510.5.2.

510.6.5 Continuing operation/supervision. The occurrence of any fault in an emergency responder radio coverage system where the system function is decreased shall result in the transmission of a supervisory signal to a supervisory service. Systems that are out-of-service for more than 8 hours require notification to the fire code official.

FIGURE 1: System Graphic

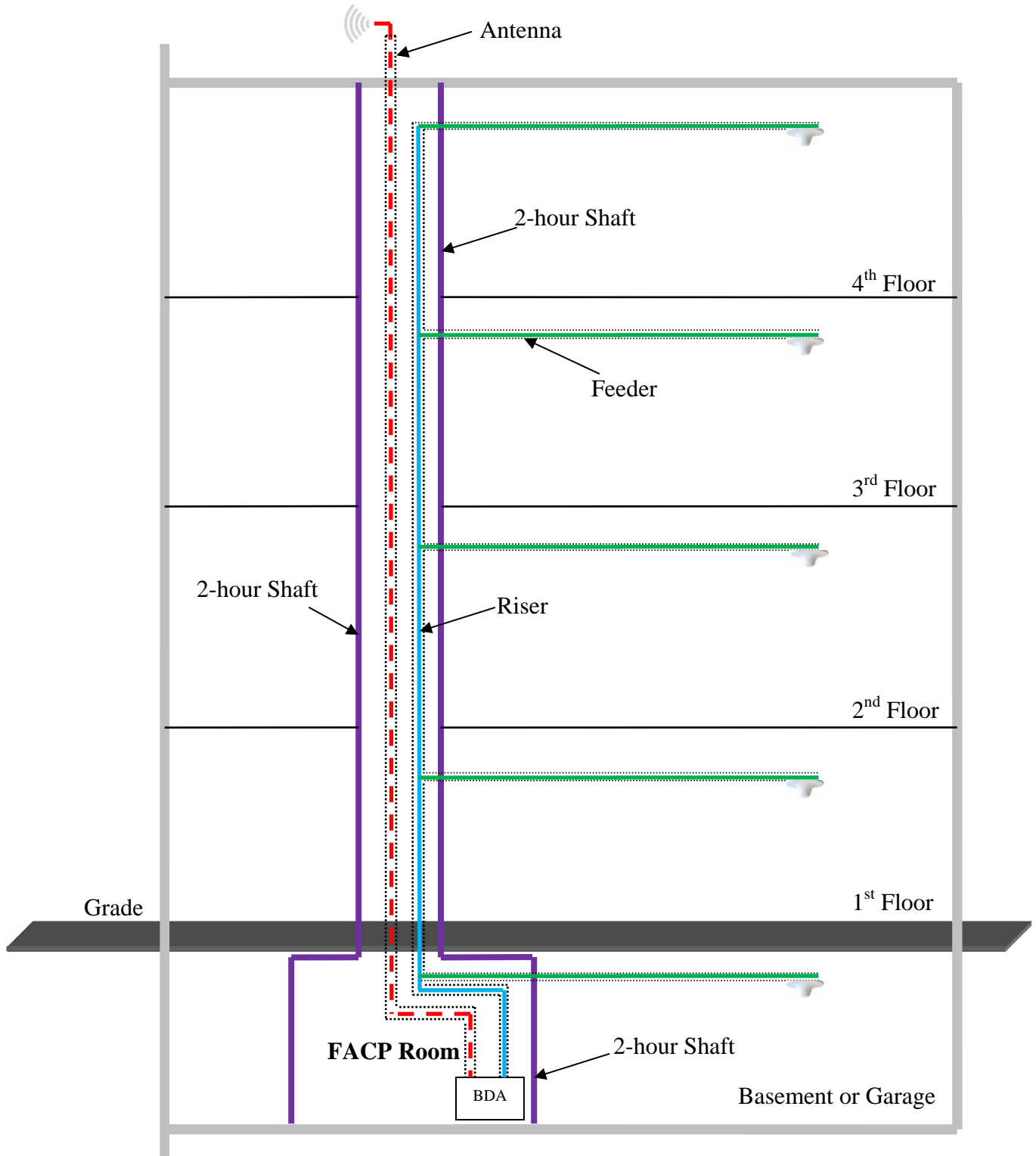
Design Details for Approved Building Signage Required in Section 510.5.6:

- 6" x 8" Sign
- ½" Lettering
- 2" x 4" Graphic
- Red Background with White Letters and Graphic



Radio System Installed

FIGURE 2: Building Section



Legend:

- - - Antenna Cable/Fiber
- Riser Cable/Fiber (must be in EMT)
- Feeder Cable/Fiber
- EMT Conduit
- 2-hour Rated Shaft

Riser/Antenna Requirements:

- Shall be protected by a 2-hour rated enclosure (shaft).
- Cable/fiber shall be plenum rated.
- Cable/fiber shall be in metal conduit (EMT) from BDA to roof termination.
- Conduit shall be properly labeled.

Feeder Requirements:

- Cable/fiber shall be plenum rated.
- Conduit shall be properly labeled.