

## Building Radio Coverage Submittal Requirements

including guidelines for best practices

February 2009

The city may require additional information as needed. If you have any questions concerning your application, please visit or call the Fire Review Desk (425-452-4122) in the Development Services Center between 8 a.m. and 4 p.m., Monday through Friday (Wednesday, 10 to 4). Assistance for the hearing impaired: dial 711.

The need for reliable communications for emergency responders includes communications inside buildings. Due to some of the construction materials, many areas inside buildings do not allow for 800 MHz radio communications from inside the building to the outside or between responders inside the building. The following are the submittal requirements for the Building Radio Coverage System and the guidelines for best practices of equipment used and locations of equipment in the building.

### Site Plans and Elevations

All plans and calculations shall be prepared by a licensed WA electrical engineer — or, at the discretion of the Bellevue Fire Department, by the licensed WA electrical contractor who shall construct the system or by the manufacturer of the proposed system.

- Plans shall be 8.5" x 11 or greater, scaled or dimensioned, with dimensions or scale clearly noted. North shall be indicated on plan views and elevations named in elevation views. Include site name, address, and elevation name or floor number on each plan sheet.
- Include a view of the subject building and surrounding property. Plan view shall clearly indicate the location and orientation of any outdoor antennas associated with the proposed systems.
- Protect the cable against physical damage. Show or state how the cable will be protected against damage if located in vertical risers or low areas in the building; preferred is to install in conduit. Show where wire risers are located in the building and note where the cable is located to keep it from being damaged.
- Include a minimum of 1 building elevations depicting the location of any outdoor antennas associated with the proposed system. Include height of antenna centerline above building, orientation, and location of all external grounding connections. The outdoor antenna shall be directional and show which site it is pointed to.
- Clearly indicate on the plans where the control amplifiers are to be located and protected.
- Include a plan view of each interior floor where indoor antenna systems are proposed. Include antenna numbers, coax routes, and the locations of any other system components, including splitters, couplers, filter, amplifiers, etc. All components shall be named or labeled for reference in power budget calculations tables. Overlay approximated coverage radii indicating a -95 dBm down link (base to mobile) signal strength around each proposed indoor coverage antenna. Include results of any previous coverage testing per grid, if available.
- Specify antenna grounding and surge protection in accordance with the *2008 National Electrical Code*.
- Specify the backup power source, and include calculations to ensure the backup power

requirements as specified in Bellevue City Ordinance 5749 are met.

- Provide plans showing each floor divided into 40 equal squares for testing or a minimum of 20x20 squares except for isolated areas.

### **Equipment Specification Sheets**

Provide copies of manufacturer specification sheets of all systems components, including:

- Amplifiers
- Antennas
- Coax, couplers, splitters, combiners, or any other passive components proposed
- Pass bank curves for the uplink and downlink portions for the NPSPAC bank for any amplifiers, if not included in #1. Amplifiers may NOT amplify portions of other licensed services, including the upper portion of the Specialized Mobile Licensee band or Cellular A or B bands.
- Backup battery and charging system (if utilized) or generator specifications

### **Ambient Signal Level Measurements**

For all proposed systems utilizing broadband amplification schemes, including bidirectional amplifiers (BDAs), ambient signal level measurements for nearby carriers in the adjacent SMR and cellular bands must be provided. This will ensure the amplifier will not be overdriven and create harmful interface as defined in 47 CFR, Parts 22 and 90.

The following measurements shall be gathered with a calibrated spectrum analyzer utilizing an omnidirectional antenna with minimal gain:

- A maximum amplitude plot ("Max Hold") of signal strength (dBm) vs. Frequency (MHz), between 863 MHz and 880 MHz. Perform measurement for at least 10 minutes during the hours of 7AM to 7PM, Monday through Friday.
- Resolution Bandwidth shall be 10 KHz.
- Place markers on any carrier measured over -55 dBm to readily identify signal strength and frequency. No more than three markers are required.
- Place one marker on the active City of Bellevue 800 MHz control channel. Those channels are 868.8750 MHz, 868.4625 MHz, and 867.9625 MHz.
- Plots should be submitted on 8.5" x 11" paper.

### **RF Power Budget Calculations**

Provide the following data for the downlink bank (866-869 MHz):

1.	Ambient EPSCA downlink signal strength @ donor antenna =	(dBm)
2.	Donor antenna gain +	(dB)
3.	Donor antenna cable system loss -	(dB)
4.	<b>Total donor antenna system gain =</b>	<b>(dB)</b>
5.	Downlink signal level at input to amplifier =	(dBm)
6.	Amplifier gain +	(dB)
7.	Amplifier multi-carrier derating, if any -	(dB)
8.	<b>Amplifier output per channel at amplifier output =</b>	<b>(dBm)</b>
9.	Amplifier maximum composite output power =	(dBm)
10.	Maximum power available per channel (assume 8 channels active)	(dBm)
11.	Indicate amplifier derating if #8 is greater than #10	(dM)

Provide the following data for ALL indoor coverage antennas:

Antenna #	Cable Length (ft)	Cable Loss per ft (dB)	Total Cable Loss (dB)	Splitter, Coupler and Combiner Losses (dB)	Antenna Make and Model	Antenna Gain (dB)	System Gain (dB)	Antenna Input Power (dBm)	Effective Radiated Power (dBm)
1									
2									
3 etc									

Provide the following uplink (821-824 MHz) calculation for antenna with smallest system gain (i.e., worst case amplification):

Antenna #	Distance to -95 dBm contour (ft)	Coupling Loss (db) <b>Constant</b>	Free Space + Clutter Loss (dB)	Total Uplink Path Loss (db)	Average Portable ERP <i>Constant</i> (dBm)	Rx Power @ Antenna (dBm)	Donor Antenna System Gain (from above)	Uplink Effective Radiated Power, Worst Case (dBm)
		<b>-10</b>			<b>35</b>			

Estimated isolation between donor antenna and indoor antenna system must be 15dB plus the total amplifier gain or greater. All information submitted will be reviewed for conformance with the *Bellevue Fire Code*, the *2008 National Electrical Code*, the FCC Rules, and other applicable codes.

### Resubmittal Requirements for Revisions or Changes to the Existing System

The revision submittal requirements are the same as above for expanding or reducing the original system.

For modification of the main panel(s), a complete resubmittal will be required, meeting all of the current code requirements.

*(over for Signal Booster Best Practices)*

## Signal Booster Best Practices

The following list is a summary of some of the "Best Practices" from the National Public Safety Telecommunications Council (NPSTC) that must be followed in compliance with Ordinance 5675. This is

intended not to be a complete list but to provide guidelines and a reference to an authoritative source of information.

- No public safety amplifiers, signal boosters, etc., may be installed without city approval.
- No specific technology is favored or endorsed; however, certain specifications restrict the use of consumer grade signal boosters for public safety applications
- All amplifiers must be Type Accepted and carry an FCC Compliance label in accordance with 47CFR sections 90.7 and 90.219.
- Wiring shall be installed in conduit unless otherwise approved in areas not subject to physical damage.
- All amplifiers must be mounted inside NEMA-rated cabinets.
- 24-hour battery backup must be provided.
- Class "A" signal boosters may be used.
- Class "B" signal boosters may be used, provided uplink filters are incorporated to limit coverage to public safety frequency bands.
- Isolation testing between donor and service antennas must be measured to ensure a minimum isolation of 15db plus amplifier gain is achieved to avoid oscillation.
- There may be no outdoor service antennas incorporated in the design.
- The system must be designed to minimize "leakage" of signals outside of the building.
- Donor antenna must be directional and aimed at the city-approved donor site.
- Prior to startup, signal levels to the donor site must be measured for compliance by a city-approved vendor.
- A coverage study must be performed after construction to ensure ordinance compliance.
- No interference to or from other radio service is allowed. Any complaints must be mitigated by the party causing the interference. This especially applies to shared commercial /public safety RF distribution systems.
- Building owners are to be informed that frequency changes may be dictated by FCC rule changes or by acquisition of additional bands or channels.
- Any revisions or changes made to a system must be pre-approved and the system re-tested for compliance.
- Annual inspection is required to ensure that the signal booster system remains in compliance.

For a more complete description of these and additional best practices,  
see [www.npstc.org/inBuilding.jsp](http://www.npstc.org/inBuilding.jsp).