Santa Barbara County Fire Department
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Development Standard - #7

EMERGENCY RESPONDER COMMUNICATION COVERAGE

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Please note that the SBCFD assumes no liability for any damages incurred directly or indirectly as a result of any errors, omissions, or discrepancies between this standard and any applicable law. It is the sole responsibility of the person or persons conducting any work pursuant to this standard to ensure their work complies with any and all applicable codes, ordinances, and regulations.

CHAPTER 1 ADMINISTRATION

1.1 PURPOSE. The purpose of this standard is to provide clarification of requirements and establish and assign an acceptable level of quality and minimum level of mandatory controls to provide and maintain sufficient radio coverage for emergency responders at buildings, projects, premises, or regions in the areas of the Santa Barbara County Fire District.

1.2 SCOPE. This standard establishes a minimum level of acceptable radio coverage for emergency communications and establishes a method to provide adequate coverage in buildings that are deficient.

1.3 APPLICABILITY. This standard shall apply to all new and existing buildings and premises within the jurisdiction of Santa Barbara County Fire Department.

1.4 FEES. A plan check fee is required for the installation of or modification to radio coverage systems as required by the current SBCFD fee schedule.

CHAPTER 2 DEFINITIONS

DELIVERED AUDIO QUALITY (DAQ): A measure of audio quality over a transmission medium defined by the following scale:

DAQ 1: Unusable. Speech present but not understandable.
DAQ 2: Speech understandable with considerable effort. Requires frequent repetition due to noise or distortion.
DAQ 3: Speech understandable with slight effort. Requires occasional repetition due to noise or distortion.
DAQ 3.4: Speech understandable without repetition. Some noise or distortion present.
DAQ 4: Speech easily understandable. Little noise or distortion.

DAQ 5: Perfect. No distortion or noise discernible.

DISPATCH CENTER: Refers to the Santa Barbara County Public Safety Dispatch Center who is responsible for dispatching County Fire, County Sheriff, and EMS.

CHAPTER 3 GENERAL

3.1 NEW BUILDINGS. All new buildings must meet the minimum performance requirements defined in section 3.3 of this standard for in-building, emergency responder communication system coverage.

3.1.2 Evaluation of Existing Coverage During Design. Expected Radio Coverage may be modeled during the design phase to determine if ERRCS will be required. However, even if modeling indicates that ERRCS should not be needed, the signal shall be tested upon completion of construction to determine if the actual conditions meet the minimum signal requirements.

3.1.2.1 Conflict. If the modeling indicated that ERRCS was not required, but actual conditions upon completion of construction do not meet the minimum requirements, a ERRCS shall be installed.

3.1.2.2 Consideration for future system. Considerations should be made to install conduit during building construction to accommodate ERRCS coaxial cables if testing indicates a system is needed to provide acceptable coverage after building construction is completed.

3.2 EXISTING BUILDINGS. Existing Buildings are required to comply when:

1) A previously required wired two-way fire department communication system is removed.

2) Within a time frame established by Santa Barbara County Fire Department.

3.3 TECHNICAL REQUIREMENTS FOR ACCEPTABLE SIGNAL STRENGTH. The building shall be considered to have acceptable in-building, two-way emergency responder communication system coverage where signal strength measurements in 95% of all areas and 99% of areas designated as critical areas by the fire code official on each floor of the building meets the requirements of this section.

3.3.1 Signal Into Building. The minimum inbound signal shall be a minimum of -95dBm with a DAQ of 3.4 or an equivalent Signal-to-Interference-Plus-Noise Ratio (SINR) applicable to the technology for either analog or digital signals.

3.3.2 Signal Out of Building. The minimum outbound signal shall provide a DAQ of 3.4 or an equivalent Signal-to-Interference-Plus-Noise Ratio (SINR) applicable to the technology for either analog or digital signals.

3.4 TOWER LOCATIONS AND FREQUENCIES. A detailed list of frequencies and tower locations is located in Appendix A of this document.

3.5 ADDITIONAL FREQUENCIES. The building owner is responsible for modifying or expanding the ERRCS at their expense if the FCC requires changes or if additional frequencies are made available by the FCC.

3.6 NEW BUILDINGS. New buildings shall not obstruct the signal strength to existing buildings without an approved mitigating plan.

CHAPTER 4 SYSTEM TESTING

4.1 TESTING REQUIREMENTS. The testing of signal strength within a building may occur when determining if a building needs ERRCS, during the acceptance test and inspection of a new system, and annually to verify a system is still providing the requisite signal.

4.2 RIGHT OF ENTRY. SBCFD personnel shall have a right to enter onto the property at any reasonable time to conduct field testing to verify the required level of radio coverage.

4.3 TESTING PROCESS. In order to determine if signal coverage meets the requirements of Chapter 3, a floor area shall be divided into a grid of 20 equal parts. Only one grid may fail in order to satisfy 95% compliance. For critical areas, the critical area shall be divided into a grid of 100 equal parts. Only one grid may fail in order to satisfy 99% compliance.

4.3.1 Acceptance Test: The acceptance test shall occur prior to the final inspection of the system. Test results shall be submitted to the SBCFD Planning and Engineering division.

4.3.2 Annual Testing: Annual testing shall occur 12 months from the date of acceptance and every 12 months thereafter. Results shall be provided to the property owner and maintained on site.

4.4 AUTHORIZED PERSONNEL. Personnel authorized to complete testing shall be licensed as a FCC General Radio Operator License (FCC GROL) and have an approved certificate of in-building system training, and not be associated with the installing contractor. All RF measurements are to be taken with equipment with proof of calibration.

4.5 DOCUMENTATION. Documentation shall include and be stored in the following manner.

4.5.1 Inspection Record Contents. Inspection records shall include the items identified in Appendix A.

4.5.2 Contents. Upon completion of installation, all approved plans, test reports, manuals, inspection records, and maintenance logs shall be stored at the site.

4.5.3 Location. All required documentation from section 4.5.2 and inspection records shall be stored within the BDA or BBU enclosure or stored externally in a rigid protective document holder.

CHAPTER 5 SYSTEM DESIGN

5.1 SYSTEM DESIGN. ERRCS shall be designed in accordance with California Fire Code (CFC), NFPA 72, NFPA 1221, and this section.

5.2 SIGNAL STRENGTH. The system shall be designed to provide at least the minimum acceptable signal strength defined in section 3.3.

5.3 POWER SOURCE. At least two independent and reliable power sources shall be provided for all active components; one primary and one standby power source.

5.3.1 Primary Power Source. A dedicated branch circuit shall supply the primary power source. The location of the branch circuit disconnecting means shall be permanently identified at all equipment supplied by the dedicated branch circuit. The system circuit disconnecting means shall be permanently identified as "EMERGENCY COMMUNICATIONS" and have a red marking. Where a circuit breaker is a disconnecting means, an approved breaker locking device shall be installed.

5.3.2 Standby Power. ERRCSs shall be provided with one of the following:

1) A storage battery dedicated to the system with 12 hours of 100% system operation capacity.

2) A 2-hour standby battery and connection to the facility generator power system, providing the facility generator power system can support the complete system load for 12 hours.

5.3.3 EPO Switch. Emergency Power-Off (EPO) means shall be provided for all ERRCS. The EPO shall be located in the Fire Command Center or adjacent to the Bi-Directional Amplifier in buildings without a Fire Command Center. The EPO shall be clearly labeled and have protection from accidental activation.

5.4 SIGNAL BOOSTER REQUIREMENTS. Signal boosters shall be Class A only and operate on the specific frequencies designated by SBCFD.

5.4.1 Signal boosters shall be located in the Fire Command Center or other area approved by the fire code official.

5.4.2 Before installation, all RF-emitting devices shall have FCC certification and be suitable for public safety use.

5.4.3 All signal booster components must be contained within a National Electrical Manufacturer's Association (NEMA) 4-type waterproof cabinet.

5.4.4 Battery systems used for the emergency power source shall be contained in a NEMA 3R or higher- rated cabinet.

5.4.5 Isolation shall be maintained between the donor antenna and all inside antennas to not less than 20 dB greater than the system gain under all operating conditions.

5.4.6 Active RF-emitting devices used for in-building, two-way emergency responder communication coverage systems shall have built-in oscillation detection and control circuitry.

5.4.7 Amplifier uplink gain shall be set to the minimum necessary to comply with the radio coverage requirements set forth herein, and not exceed 65 dB unless approved by the fire code official.

5.4.8 Bidirectional amplifiers shall not exceed -150 dBm uplink noise at the donor site, -43 dBm ERP uplink noise within the authorized passband, and -70 dBm ERP uplink noise at 1 MHz outside the authorized passband when in a quiescent state. A reduction in quiescent noise may be required dependent upon the distance of the bidirectional amplifier from the donor site.

5.4.9 The installation of amplification systems or systems that operate on or provide the means to cause interference on any in-building, two-way emergency

responder communication coverage network shall be coordinated and approved by the fire code official.

5.5 SYSTEM MONITORING/INTERCONNECTION. A listed fire alarm control unit must monitor the ERRCS, or where approved by the fire code official, shall sound an audible signal at a constantly attended on-site location. A dedicated annunciator shall be provided to annunciate the status of all RF-emitting devices and active system component locations within an area acceptable to the fire code official. Monitoring requirements include the following:

1. Monitoring for integrity of the system shall comply with Chapter 10 of NFPA 72.
2. Automatic supervisory signals shall include the following:
    a. Loss of normal AC power supply.
    b. System battery charger(s) failure.
    c. Malfunction of the donor antenna(s).
    d. Failure of active RF-emitting device(s).
    e. Low-battery capacity at 70% reduction of operating capacity.
    f. Failure of critical system components.
    g. The communications link between the fire alarm system and the ERRCS.
    h. Oscillation of active RF-emitting device(s).

5.6 OPERATIONAL FREQUENCY. The ERRCS 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. The ERRCS must be operational on both 700 and 800 MHz Public Safety bands and operate on all assigned frequencies required by SBCFD.

5.7 RADIO COMMUNICATION ANTENNA DENSITY Systems shall be engineered to minimize the near-far effect. Radio enhancement system designs shall include sufficient antenna density to address reduced gain conditions.

5.7.2 Antenna placement and downlink gains shall be designed to prevent RF leakage and to avoid downlink levels exceeding -75dBm at or near the building interior perimeter.

5.7.3 RF Leakage from the system shall not present a measured level in excess of 15dB below the measured Donor signal at ground level in the immediate area (3-25') from the building perimeter.

5.8 PROTECTION OF ERRCS. System components shall be protected from physical damage in accordance with this section.

5.8.1 The backbone, antenna distribution, radiating, or any fiber-optic cables shall be rated as plenum cables.

5.8.2 The backbone cables shall be connected to the antenna distribution, radiating, or copper cables using hybrid coupler devices of a value determined by the overall design.

5.8.3 Backbone cables and active components shall be routed through an enclosure that matches the building's fire rating.

5.8.3.1 In buildings where the primary structural frame does not have a fire rating, but 1-or-2 HR rated enclosures such as stairways or vertical shafts are required, the backbone and active components shall be located within a rated enclosure or provided with a fire resistance rating of at least the same value.

5.8.4 Passage of the antenna distribution cable in and out of the enclosure shall be fire-stopped.

5.8.5 All cables shall be installed in accordance with Chapters 7 and 8 of the California Electrical Code (CEC).

5.8.6 Mechanical protection of work and raceways for coaxial cables shall comply with Article 820 of CEC.

5.8.7 Cables that are susceptible to mechanical damage must be protected by electrical metallic tubing (EMT) or metal raceways.

5.9 LIGHTNING PROTECTION. Antenna and system components shall be protected from damage from lightning.

5.9.1 The donor antenna coaxial cable(s) shall be protected by antenna discharge units in accordance with Article 820 of CEC.

5.9.2 The antenna discharge units shall be listed to UL 497C, Standard for Protectors for Coaxial Communications Circuits.

5.9.3 Each donor antenna coaxial cable(s) shall be provided with a listed antenna discharge unit in accordance with Article 820 of CEC.

5.9.4 The antenna, antenna mast, and antenna discharge unit(s) shall be grounded in accordance with Article 820 of CEC.

CHAPTER 6 PLAN REQUIREMENTS

6.1 PLAN SUBMITTAL. Specifications for ERRCS shall be drawn with care by a trained person. Plans shall be drawn to an indicated scale of not less than 1/8 inch = 1 foot and digitally submitted to Planning and Engineering by emailing digital copies of all documents to pe.submittals@countyofsb.org. The following items shall be included in all ERRCS plan specifications:

6.2 FORMAT. All ERRCS plans shall be formatted in accordance with the following:

1) All submittals shall be in PDF format.
2) File names shall contain the project name, revision number (if applicable), and date of filing.
3) If submitted as separate Plans and Materials Files, the file name must indicate the content.
4) Minimum Architectural D (36” x 24”)
5) All pages must be of the same dimension.
6) Material data sheets may be submitted as a separate document in booklet format, 8.5” x 11” with cover sheet and full materials list included
7) All pages shall include:
    a. Project name
    b. Revision
    c. Page identifier
    d. Page description

6.3 COVER PAGE/TITLE SHEET. The cover page/title sheet shall include the following:

1) Project name and address
2) Building description including:
    a. Usage
    b. Construction type
    c. Number of floors above and below grade
    d. Proposed square footage
    e. Occupancy classification
    f. Fully sprinklered: Yes or No
3) Property Owner contact information
4) System Designer's and Lead Installer's contact information
5) Vicinity map showing property location
6) Scope of work
7) Proposed start and finish dates of project
8) Full description of concept including any phases represented or connection to existing or future elements
9) Document index

6.4 FLOOR PLANS, EXTERIOR ELEVATIONS AND AREA DRAWINGS shall contain**:**

1**.** Legend
2. Scale/dimensions (graduated ruler)
3. Compass orientation
4. Unique identifier of all components shown including major cable segments

6.5 DOCUMENTS. The following documents shall be included.

1. Compliance statement(s) to ALL applicable and currently adopted editions of codes/standards, including but not limited to CFC, CBC, CEC, NFPA Standards, and SBCFD ERRCS Guidelines.
2. Minimum Designer & Lead Installer qualifications to include:
    a. FCC GROL License verification
    b. Certification of in-building system training (as previously identified)
3. Materials list (all active and passive components excluding small hardware)
    a. Manufacturer
    b. Full model or part number
    c. Manufacturer's description
    d. Quantities for each device
    e. BDA type, model number, and serial number (if available)
    f. BDA FCC ID number

6.6 PHYSICAL INSTALLATION DETAILS AND REQUIREMENTS shall include:

1. Wall and floor penetration details
2. Equipment mounting details and construction standards
3. Electrical, dedicated branch, lightning protection, ground, and alarm cabling details
4. Fireproofing requirements

6.7 UNIQUE IDENTIFIERS. A list of unique identifiers for all components and major cable segments shall be provided.

6.8 SCHEMATIC DIAGRAM. A Schematic Diagram of the proposed system showing unique identifiers of all components with:

1. Active devices
2. Antennas
3. Splitters, taps, etc.
4. Cable segments

NOTE: Unique identifiers MUST be represented on all line drawings and floor plans.

6.9 SYSTEM MONITORING INFORMATION. Plans shall include the system monitoring information identifying all supervisory signals as required by CFC.

6.10 LINK BUDGET ANALYSIS. A Link budget analysis shall be provided describing uplink at donor and downlink power at each DAS Antenna. Analysis shall provide the following.

1. Provide full calculations for each segment or point in tabular format.
2. Provide schematic representation showing power projections at each junction or connection point.

6.11 ATTENUATION. Plans shall include anticipated attenuation for each cable segment and device port.

6.12 DONOR SITE SIGNAL PATHS shall be demonstrated to include:

1. List of all frequencies to be amplified by system.
2. Area map showing donor site location and path to designated donor site
    a. Show both vertical and horizontal path views

6.13 FLOOR PLANS. Floor plans shall be included for all levels, including levels not covered by the system.

1. Showing all components with identifiers
2. Cable routes and identifiers
3. Identifying BDA and backbone enclosure or shaft location, and fire rating via wall legend

6.12 RACK OR WALL MOUNT ELEVATIONS including attachment method and grounding details shall be included in the form of graphics with notes.

6.13 FIBER OPTICS LAYOUT. Fiber optics layout and interconnect where applicable shall be detailed on the plan.

6.14 HEAT MAPS, typically iBwave or Ranplan, shall be included for every floor.

1. Divide each floor into 20 approximately equal sized grids.
    a. Assign a unique ID to each grid. This grid system shall be used for initial coverage calculations and all future test documentation.

6.15 BATTERY BACK-UP calculations for the system shall be included.

6.16 MANUFACTURER'S DATA SHEET shall be included for all:

1. Active components (displaying UL 2524 listing)
2. Antennas
3. Passive coupling devices (taps, power dividers, etc.)
4. Coaxial cable
5. Coaxial connectors
6. Fiber cable (if used)
7. Fiber connections (if used)
8. Enclosures to be provided by contractor

CHAPTER 7 INSTALLATION REQUIREMENTS

7.1 INSTALLATION OF ERRCS. Installation shall comply with this chapter and shall be in accordance with approved plans.

7.2 PERSONNEL QUALIFICATIONS. The system designer and lead installation personnel must meet the following qualifications:

1. A valid FCC–issued General Radio Operators License (GROL); and
2. Certification of in-building system training issued by a nationally recognized organization, schools such as Associated Public Safety Communications Officials International (APCO), National Association of Business and Education Radio (NABER), Wireless Infrastructure Association (WIA) or the International Association for Radio, Telecommunications and Electromagnetics (iNARTE) or a certificate issued by the manufacturer of the equipment being installed; or an ERRCS certification by the National Institute for Certification in Engineering Technologies (NICET).

7.3 APPROVAL. No amplification system capable of operating on frequencies used by the Public Safety 145/160 MHz Radio Systems may be installed without prior coordination and written Authorization to Operate from the Santa Barbara County Public Safety Dispatch Center. Any such system shall comply with any standards adopted by this agency.

7.4 FCC COMPLIANCE. The ERRCS installation and components shall comply with all applicable federal regulations including, but not limited to, FCC 47 CFR Part 90.219. Proof of registration with the FCC shall be provided to the SBCFD.

7.5 DONOR ANTENNAS. To maintain proper alignment with the system designed donor site, donor antennas shall be:

1. Highly Directional
2. Secured to a structure strong enough to carry the weight of the installation with necessary allowances for wind and vibration and shall be permanently affixed to the building.
    a. Attachment to the riser cable conduit is permissible if the conduit is appropriately supported and secured to structural elements of the building on the roof.

3. Antennas shall not be attached to or supported by vent pipes.
4. Mast supports and guy-wire anchors shall be secured in such a way that the supporting structure is not damaged or weakened.
5. Masts which extend more than eight feet above the top of their mounting point shall provide structural design submittals prepared by and bearing the stamp of a registered design professional.
6. The antenna installation shall be in accordance with the applicable requirements in the California Building Code for weather protection of the building envelope.

7.6 ACCEPTANCE TEST. Upon completion of both building construction and ERRCS installation, the system is required to be tested to ensure that the two-way coverage on each floor of the building is not less than 95% and 99% of critical areas. Coverage shall be based on operation with fire door(s) closed. The test procedure shall follow the requirements of CFC 510.5.4.

NOTE: Acceptance testing is required to be performed by a third-party qualified testing entity, not employed by or related to the ERRCS installation contractor. DAQ shall be measured using an instrument which decodes the APCO Project-25 bitstream and provides a SINR or SNR measurement. A passing SNR or SINR is 20 dB or greater, and a passing BER is no greater than two percent.

7.7 INSPECTION. A fire department inspection shall be required to verify the installation and results of the acceptance testing report. After fire department inspection of the ERRCS installation, a stamped/approved version of the acceptance report will be returned to the testing contractor.

7.8 FINAL DOCUMENTS. Before issuance of a certificate of occupancy, a final acceptance testing report and as-built plans shall be submitted to SBCFD.

APPENDIX A
FREQUENCY AND RADIO TOWER DETAILS

Channel	Receive/Uplink Frequency	Transmit/Downlink Frequency
SBC Fire Ch1	153.77000	154.25000
SBC Fire CMD 2	153.90500	154.99500
SBC Fire CMD 3	153.98000	155.71500
SBC Fire CMD 4	156.13500	154.95000
SBC Fire CMD 5	154.87500	155.13000
SBC Fire CMD 6	150.99500	154.80000

Radio Tower Site Details

Site Name	Latitude (N)	Longitude (W)	Channels
Casino	34° 36' 29"	120° 05' 15"	SO 1-2, Fire 1-3, Med 10
Chalk Hill, Solvang	34° 35' 47"	120° 08' 08"	
Comm Hill	N/A	N/A	Fire 1-3, LG1 S, LG2 S All RX Only
Foster	34° 52' 55"	120° 26' 39"	SO 1-2, Fire 1-3, Med 10 All RX Only
Gaviota	34° 30' 46"	120° 13' 52"	SO 1, Fire 1, Fire 3, Med 10
Harris	34° 44' 19"	120° 26' 45"	SO 1-2, Fire 1-6, Med 10, LG1 N, LG2 N
La Cumbre	34° 30' 01"	119° 43' 16"	SO 1-2,Fire 1-6, Med 10, LG1 S, LG2 S
Los Alamos	N/A	N/A	SO 1-2, Fire 1-3 All RX Only)
Plowshare	35° 03' 00"	120° 02' 27"	SO 1-2, Fire 1-6, Med 10, LG2 N
Purisima	34° 41' 05"	120° 09' 07"	N/A
Rincon	34° 22' 22"	119° 25' 15"	SO 1-2, Fire 1-6, Med 10, LG1 S, LG2 S
Santa Ynez	34° 31' 36"	119° 58' 42"	SO 1-2,Fire 1-6, Med 10, LG1 S, LG1 N, LG2 S,
Solvang	34° 35' 47"	120° 08' 08"	SO 1-2, Fire 1, Med 10 All RX Only
Sudden	34° 33' 59"	120° 29' 59"	SO 1, Fire 1 RX, Fire 3, Med 10, LG1 N RX
Tepusquet	34° 54' 54"	120° 10' 57"	SO 1-2,Fire 1-6, Med 10, LG1 N, LG2 N
Vic Trace	34° 24' 16"	119° 42' 12"	Fire 1 RX
White Hills	34° 34' 13"	120° 21' 16"	SO 2, Fire 3, RX

APPENDIX B
TESTING REPORT REQUIRMENTS

COVER PAGE SHOWING:

1. Site name and address
2. Date(s) of inspection
3. Site Owner name address, phone number and email address
4. On site (24/7) contact, full name, address, phone number & email address
5. Testing company's contact information
6. Inspector's name, contact address, phone number and email address

INSPECTOR'S PROOF OF QUALIFICATIONS INCLUDING:

1. FCC GROL
2. Certification of in-building system training (as previously identified).

TEST DESCRIPTION

1. Test requirements per CFC and SBCFD Guidelines
2. Test methodology
3. Model, serial number and calibration date of all testing equipment

SITE DESCRIPTION

1. Site address
2. Site donor antenna
3. BDA FCC registration number
4. Location of primary components within the property
5. Model, serial number and FCC certification number of all active RF components including:
    a. Amplifier or Master Unit
    b. Remote Amplifiers
6. Amplifier operating Class (Class A required).
7. Model and serial number of remaining powered components.
    a. Battery Backup Units (BBU)
    b. Remote Alarm Reporting Devices

INSPECTION RESULT SUMMARY PAGE

1. List requirements and Pass/Fail Result
    a. Interior Signal Strength (Downlink)

b. Exterior Signal Strength (Uplink)
c. General Areas – 95% Coverage Test
d. Critical Areas – 99% Coverage Test
e. DAQ test (Uplink & Downlink)
f. Correct Frequency Filtering
g. Uplink Muting Enabled
h. Spurious Uplink Emissions Measurement
i. Quiescent Noise Measurement
j. Donor Antenna Azimuth (specify degrees True or Magnetic)
k. Donor to Serving Antenna Isolation Less Maximum BDA > 20 dB
l. Primary Power Provided by Dedicated Branch Circuit
m. Backup Power Supply Provides Power for All Active Components
n. Backup Power Supply Battery Condition
o. Backup Power Supply Calculated Runtime
p. Backup Power Load Test
q. Physical Condition of Installation
r. NEMA 4/3R compliance of Equipment Enclosures Inter-cabinet cabling 19. AC Power Termination
s. Emergency Power-Off device
t. Grounding and Lightning Protection
u. Interference Test
v. Isolation Tests
w. Amplifier Gain Measurements
    i. Uplink ii.. Downlink
x. Active Components are UL2524 Listed
y. BDA FCC Certification
z. Any other applicable test results

DETAILED TEST RESULTS

1. Donor Site Path Profile
    a. Local Site coordinates
    b. Donor Site(s) coordinates
    c. Graphic representation of horizontal and vertical paths showing:
        i. Donor Site(s) Name
        ii. Azimuth (degrees Magnetic) to Donor Site(s)
        iii. Path Length to Donor Site(s) (Miles)
        iv. Calculated Path Loss to each donor site

2. Graphic or tabular verification for all required tests (following)
    a. System primary and backup power
        i. One-hour load test or pulse-load battery capacity test.
        ii. Verify ALL active components operating on backup power including Amplifier/Master (Headend), Remote amplifiers, Fault display
    b. System gain and measured RF power
        i. Uplink and downlink
        ii. Single channel
        iii. Near-far (uplink only)
    c. Ambient noise floor
        i. Measured at BDA Donor antenna feed point and BDA service antenna feed point
        ii. Amplifier powered off
        iii. Active DAS, if used, powered on
        iv. Show span of 15-20MHZ centered at each Transmit and Receive frequency being used.
        v. Provide a screenshot displaying noise entering BDA from donor antenna at both frequencies as described in item 3d (above)
        vi. Provide a screenshot displaying noise entering BDA from service antennas at both frequencies as described in item 3d (above)
        vii. If an active DAS is used, provide a screenshot of the noise entering the BDA from the active DAS
    d. Active noise floor
        i. Repeat item 3 with power applied to BDA, with all antennas connected.
    e. Quiescent noise a. BDAs shall not exceed -150 dBm uplink noise at the donor site, -43 dBm ERP uplink noise within the authorized passband, and -70 dBm ERP uplink noise at 1 MHz outside the authorized passband when in a quiescent state. A reduction in quiescent noise may be required dependent upon the distance of the bidirectional amplifier from the donor site.
    f. Antenna systems isolation
        i. Inject reference signal to DAS antenna system at receive frequency.
        ii. Show Injected power level
        iii. Show Measured signal from Donor antenna system

g. Coverage measurement
   i. Coverage shall be based on operation with fire door(s) closed.
   ii. Using 20-grid method created in the original plan set, conduct measurements on each floor. Minimum acceptable is -95 dBm in 95% of the test grid and 99% of critical areas.
   iii. Determine and document uplink and downlink DAQ for all grids. Minimum acceptable is DAQ 3.4 in 95% of test grid areas on every floor and 99% critical areas.
   iv. DAQ shall be measured using an instrument which decodes the APCO Project-25 bitstream and provides a SINR or SNR measurement. A passing SNR or SINR is 20 dB or greater, and a passing BER is no greater than two percent.

INSPECT AND DOCUMENT

1. Physical condition of equipment and installation
   a. Provide digital images of:
      i. Headend and Remote equipment – showing required labeling
      ii. Headend and Remote cabling
      iii. Donor Surge Protector
      iv. Donor antenna and supporting structure
      v. Donor antenna alignment and path to Donor site(s)
      vi. Interior of BBU cabinet
      vii. Typical DAS antenna
      viii. Any items requiring repair or support

NOTE: Digital images of physical condition of equipment and installation are not required for Annual testing reports.