SECTION 27 53 19
Emergency Responder Radio Coverage System (ERRCS)

PART 1 GENERAL

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1.01 Summary
A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:

1. Distributed antenna system supporting public safety emergency responder radio coverage system (ERRCS)

B. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

1.02 References
A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:

1. American National Standards Institute, Inc. (ANSI)/ Telecommunications Industry Association (TIA):
   a. ANSI/TIA-568-C. O; Generic Telecommunications Cabling for Customer Premises (February 2009)
   b. ANSI/TIA-568-C.1; Commercial Building Telecommunications Cabling Standard Part 1: General Requirements (February 2009)
   c. ANSI/TIA-568-C.2; Balanced Twisted-Pair Telecommunications Cabling and Components Standards (April 2010)
   d. ANSI/TIA-568-C.3; Optical Fiber Cabling Components Standards (June 2008)
   e. ANSI/TIA-569-B; Commercial Building Standard for Telecommunications Pathways and Spaces (May 2009)
   f. ANSI/TIA-606-A; The Administration Standard for the Telecommunications Infrastructure of Commercial Building (November 2008)
   g. ANSI/TIA-J-607-A; Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications (October 2002)


   a. NFPA 1221: Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems 2016 or edition referenced in the CFC
   b. NFPA 72: National Fire Alarm and Signaling Code 2016 or edition referenced in the CFC
5. CFC Section 510: Emergency Responder Radio Coverage or current edition of California Code of Regulations (CCR)
9. UL 2425 Certification – All RF emitting active equipment.
10. Silicon Valley Radio Interoperability Agency: Specific Performance and Testing Requirements. (attached, Rev. Date 09/1/20)

1.03 Abbreviations
A. AHJ: Authority having jurisdiction (or simply stated as the “local jurisdiction”)
B. DAQ: Delivered Audio Quality

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<th>Definition</th>
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<td>1</td>
<td>Unusable. Speech present but not understandable.</td>
</tr>
<tr>
<td>2</td>
<td>Speech understandable with considerable effort. Requires frequent repetition due to noise or distortion.</td>
</tr>
<tr>
<td>3</td>
<td>Speech understandable with slight effort. Requires occasional repetition due to noise or distortion.</td>
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<tr>
<td>3.4</td>
<td>Speech understandable without repetition. Some noise or distortion present.</td>
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<tr>
<td>4</td>
<td>Speech easily understandable. Little noise or distortion.</td>
</tr>
<tr>
<td>4.5</td>
<td>Speed easily understandable. Rare noise or distortion.</td>
</tr>
<tr>
<td>5</td>
<td>Perfect. No distortion or noise discernible.</td>
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</table>

C. DAS: Distributed antenna system
D. ERRCS: Emergency responder radio coverage system
E. PS: Public safety
F. PSN: Public safety network
G. RSL: Received signal level
H. SNMP: Simple network management protocol
I. RSSI: Received Signal Strength Indicator
J. EPO: Emergency Power Off
K. FCC: Federal Communications Commission
L. SUFMO: Stanford University Fire Marshal Office

1.04 System Description
A. Public Safety ERRCS is defined as a two-way wireless radio communications system that is used by first responders and emergency services, such as fire personnel, medical and ambulance services, police, first responders and disaster response units. This system is used exclusively to respond to emergency situations where there is a threat to life and property.
B. Codes and Requirements from CFC Section 510 Emergency Responder Radio Coverage, NFPA 1221, and local ordinances (see appendix A and B for local standards from Santa Clara County and Palo Alto)
1 Coverage Areas
   a. All general building areas shall have radio coverage for at least 95% percent of the floor space. All critical areas such as fire command centers, exit stairs, exit
passageways, fire pump rooms and elevator lobbies should have provided with a minimum of 99% floor area radio coverage.

2. Signal Strength
   a. Inbound: Signals shall be minimum −95 dBm. This signal strength should hold throughout the area under coverage and provide a minimum DAQ 3.4 (digital systems) or better.
   b. Outbound: A minimum outbound strength sufficient to provide usable voice communications as specified by the AHJ, shall be provided throughout the coverage area. The outbound signal level shall be sufficient to provide a minimum of DAQ 3.4 for digital system for outbound signals as is required by CFC, PAFD, & SCCFD for inbound signals.

4. Enhancement Requirements
   a. All new buildings shall install an ERRCS unless specifically waived by the local jurisdiction. If an existing building or structure cannot support the minimum level of radio coverage required by the CFC or local ordinance, the local jurisdiction can require the building be enhanced to offer sufficient radio coverage. This evaluation is generally part of large, major building renovation projects.

C. The ERRCS pathway system with appropriate pathway survivability shall be provided regardless of signal strength.

D. The contractor shall propose, design and deploy an ERRCS system capable of receiving permanent approval of the authority having jurisdiction (AHJ). The contractor shall coordinate and submit all documentation required for AHJ approval.

E. The contractor shall design the ERRCS system to be balanced to overcome the near far effect problem.

F. The contractor shall design the system with a signal to noise ratio to provide a usable signal 20dB above the noise floor.

G. Isolation between donor antennas and indoor antennas will be a minimum of 20dB.

G. Contractor will identify all pathway survivability (as defined by NFPA 1221) to include:
   1. Donor Antenna pathway to be 2 hour rated (Level 2 Survivability)
   2. Horizontal antenna infrastructure pathways to meet level 1 survivability where required.
   3. Fiber Optic pathways to be 2 hour rated (Level 2 Survivability)

I. All active equipment including BDA, headend, UPS and fiber remotes to be in a 2-hour rated room or enclosure.

J. The contractor will provide BTU specs for each active piece of equipment and required operating temperature.

K. The contractor will provide required electrical load for each location of equipment and coordinate a dedicated circuit with lock out at the electrical panel.

L. All bi-directional amplifiers, fiber optic headend and fiber optic remotes will have 24 hours operational backup by a Uninterruptible Power Supply (UPS).

M. All UPS units, AC power supplies, bi-directional amplifiers, fiber optic remotes, fiber optic headend(s), to be monitored by the fire alarm panel and dedicated annunciator panel for DAS.

N. Network Management:
   1. The DAS shall have a network management system capable of alarm, monitoring, configuration and control of all active components.
   2. The DAS shall be capable of integration with 3rd party SNMP based Network management system products for alarm purposes and provide alarming information.

O. The ERRCS components covered herein include:
   1. Bi-directional amplifiers
   2. Fiber-optic master unit
   3. Remote units
   4. Fiber optic cables and connectors
5. Donor antennas
6. Coverage antennas
7. Coaxial cable and connectors
8. Directional splitters, Wilkinson power dividers, combiners, and couplers
9. UPS back-up battery system for ERRCS
10. Remote monitoring capabilities via fire alarm system
11. Emergency power off switch

1.05 Submittals

A. Procedure: Shop drawings, calculations, and product data sheets shall be submitted to SUFMO for review and approval prior to submission to the local jurisdiction and the purchase and/or installation of equipment. Submissions to SUFMO for review and approval are to be PDF only, unless otherwise approved.

B. Shop Drawings: Shop drawings shall be computer generated (AutoCAD compatible DWG format) drawings, compatible with Stanford requirements, and shall include all items required by this section. Drawings shall show both the existing condition to be modified and new condition after installation where appropriate.

C. Submit in accordance with the requirements of (Electrical section and section 28 31 00) the following items:
   1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
   2. Submittal Drawings to include:
      a. To scale floor plans showing the location of system components
      b. Riser and schematic diagrams
      c. Detail drawings for donor antenna, location, azimuth and grounding
      d. Donor site location, distance and link budget
      e. Detailed BOM
      f. Wire and cable legend to include pathway survivability
      g. Propagation heat maps in color
      h. Battery calculations
      i. Link Budgets
      j. Near Far Effect calculations
      k. Third party initial test results
      l. EPO function and wiring
      m. Furnish structural calculations for equipment anchorage as described in Stanford Facilities Design Guideline
      n. Submit Manufacturer's installation instructions.
      o. Final test results.
      p. Warranty.
      q. Detail of system labeling
      r. Document box location

1.06 Operation and Maintenance Manuals

A. Supply operation and maintenance manuals in accordance with the requirements of Stanford Facilities Design Guideline, to include the following:
   1. A detailed explanation of the operation of the system.
   2. Instructions for routine maintenance.
   3. Pictorial parts list and part numbers.
   4. Pictorial and schematic Electrical Drawings of wiring systems, including operating and safety devices, control panels, instrumentation and annunciators.
   5. Telephone numbers for the authorized parts and service distributors.
6. Include all service bulletins and torque specifications for all terminations.
7. Final testing report.

1.07 Quality Assurance

A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.

B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

C. Installer's requirements:
   1. Installation personnel shall have an FCC issued general radio operator's license (GROL).
   2. Certificate from the manufacturer of the equipment to be installed stating that the ERRCS installer is trained/qualified on the equipment.

D. Designer's requirements:
   1. iBWave Software Certifications
   2. Design personnel shall have an FCC issued general radio operator's license (GROL).
   3. Certificate from the manufacturer of the equipment to be installed stating that the DAS installer is trained/qualified on the equipment.

E. Engineer's requirements:
   1. Engineering personnel shall have an FCC issued general radio operator's license (GROL).
   2. Certificate from the manufacturer of the equipment to be installed stating that the DAS installer is trained/qualified on the equipment.

1.08 Product Delivery, Storage and Handling

A. Delivery: Equipment components shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to manufacturer at no cost to Owner. Components shall be properly packaged in factory-fabricated containers and mounted on shipping skids.

B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.

C. Handling: Handle in accordance with manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed.

1.09 Warranty

A. Units and components offered under this Section shall be covered by a one (1) year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

1.10 System Start-Up

A. Upon completion of installation, a factory trained service technician shall perform initial start-up of the equipment. Sufficient time shall be allowed to properly check the system out and perform required minor adjustments before the Engineer's witnessed test shall begin.
PART 2 PRODUCTS

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2.01. Performance Requirements
2.02. Headend Equipment
2.03. Donor Antenna
2.04. Donor Antenna Infrastructure
2.05. Remote Units
2.06. Service Antenna Infrastructure

2.01 Performance Requirements
A. Public safety emergency responder radio coverage system (ERRCS):
   1. The public safety ERRCS shall comply with CFC, local ordinances, NFPA-1221 and NFPA-72.
   2. Contractors shall state the assumed channel count for the ERRCS frequency bands identified above with submittal. Prior to installation, contractors shall confirm the channel count and frequencies with the AHJ and shall guarantee coverage for these channels per the criteria stated above.
   3. The ERRCS shall deliver coverage per the criteria in Table 1 throughout 95% of all occupied building spaces and 99% in critical areas as defined in NFPA 1221.
   4. The ERRCS shall be monitored by a dedicated annunciator panel and provide monitoring points for fire alarm system connections to comply with the following for system and power supply supervisory signals. The ERRCS installer shall be responsible for all connections up to and including the annunciator. All wiring between annunciator and the fire alarm panel will be the responsibility of the designated fire alarm vendor:
      a. Donor Antenna Malfunction
      b. Active RF emitting device failure
      c. Low-battery capacity indication when 70 percent of the 24-hour operating capacity has been depleted
      d. System component failure – including optic failures
      e. Loss of normal ac power
      f. Failure of battery charger

2.02 Headend Equipment
A. 700MHz Bidirectional amplifier:
   1. BDA: The BDA shall be an FCC class A certified.
   2. Characteristics:
      a. Operating temperature range: -25 °C to +55 °C
      b. Chassis: Shall meet NEMA 4 requirements per code.
      c. Alarming: Shall support SNMP
      d. Mounting options: Shall support rack and wall mounting
      e. Supported frequency band: 758-805 MHz
      f. Power Consumption ≤ 120W
      g. -48 VDC power input
      h. Channel bandwidth size of 6.25-12.5 KHz
      i. Provide channelized auto level control
   3. Compliance:
a. NFPA: The BDA shall comply with NFPA-1221, requirements for supervision and monitoring.
b. FCC: Shall be FCC type certified.
c. Products will be UL2524 listed.

4. Preferred Manufacturer: Comba Telecom, or equivalent

B. Fiber-optic master unit:

1. Building size or campus requirements may dictate an active fiber DAS, the fiber-optic master unit shall convert radio over coax to radio-over-fiber (RoF) for distribution to fiber-optic remote units.

2. Characteristics
   a. Transmission Media: Single-mode fiber at 1310 nm
   b. Operating Temperature Range: -10 °C to +50 °C
   c. Chassis:
      i. Shall be of modular design capable of supporting up to 32 Remote Units per 19", 4 RU chassis
      ii. Shall support redundant power supplies
   d. Automatic gain control (AGC): Shall provide AGC for optical loss compensation
   e. Optical budget: Shall support ≤ 3 dB optical budget (~3 km or 2 miles)
   f. Remote supervision:
      i. Shall support the TCP/IP protocol, SNMPv2, FTP, HTTP, Telnet, and be fully compatible
      ii. Remote access shall be available via point-to-point protocol, over circuit-switched/packet data
   g. Each active device shall be manageable via a Web GUI
   h. Frequency Bands Supported: 758-805 MHz

3. Compliance:
   a. NFPA: The BDA shall comply with 2019 NFPA-1221, chapter 9 requirements for supervision and monitoring.
   b. FCC: Shall be FCC type certified.
   c. Products will be UL2524 listed

4. Preferred Manufacturer(s): Comba Telecom, or Solid Technologies, or equivalent

C. Remote Units

1. The fiber-optic remote unit converts the RoF signal back to radio over coax, as well as provides filtering so that multiple frequency bands can reside over the same passive cable and antenna infrastructure.

2. Electrical characteristics:
   a. Operating temperature range: -10 °C to +50 °C
   b. Impedence: 50 Ohm
   c. Frequency bands supported: 758-805 MHz
   d. Optical port: SC-APC connector
   e. Antenna port: 50 Ohm N-type, female connectors

3. Enclosure:
   a. Wall or Rack Mounted
      1. NEMA 4 rated

4. Compliance:
   a. NFPA: The BDA shall comply with 2019 NFPA-1221, chapter 9 requirements for supervision and monitoring.
   b. FCC: Shall be FCC type certified.
   c. Products will be UL2524 listed

5. Preferred Manufacturer (s): Comba Telecom, or Solid Technologies, or approved equivalent

E. Uninterruptible Power Supply (UPS)
1. A UPS system shall be provided for the ERRCS system to support all electrical components upon loss of utility power. UPS battery backup shall have a duration of 24-hours at full load. All UPS shall be in a NEMA 4 rated enclosure. All UPS shall have an EPO switch installed next to or as part of the enclosure.
   a. Where allowed by Stanford and the AHJ, if an emergency generator is provided on the project, the battery duration can be offset by the generator, but cannot be eliminated entirely. As a minimum, the batteries shall provide 2-hours of backup in this case.

2. Uninterruptible power supply (batteries)
   a. Provide an uninterruptible power source for all active system components with backup from the building emergency generator when available. Power source shall consist of, but not be limited, to all necessary conduits, wire, outlets, transformers, panels and connections to each piece of equipment as required.
   b. Uninterruptible power shall be required such that loss of power shall not cause the system operator to be required to restart the system or any part thereof upon return of power. The uninterruptible power supply shall be NFPA approved for applications and shall provide a 24-hour backup of the system.

3. Emergency Power Off (EPO)
   a. The UPS system shall be equipped with an EPO switch in a location approved by the fire code official. The EPO shall disconnect both the circuit breaker and secondary power supply simultaneously.

2.03 Donor Antenna
   A. Donor Antenna’s must be of corner reflector type or a comparable donor antenna with high isolation.
      1. Electrical characteristics:
         a. 698~940 MHz, 26-degree min H/V beam width, 32 dB front to back ratio.
         b. Frequency 698~806MHz | 806~940MHz
         c. Horizontal Beamwidth 29.2°±1.8° | 25.9°±1.6°
         d. Vertical Beamwidth 29.9°±2.5° | 26.6°±4.0°
         e. Front to Back Ratio>31dB
         f. Intermodulation>153 dBc @ 2 tone x 43 dBm
         g. VSWR<1.5 : 1
         h. Impedance 50Ω
         i. Power Rating (max)100W
         j. Polarization Vertical

2.04 Donor Antenna Infrastructure
   A. Donor antenna cabling (roof only)
      1. Construction materials:
         a. Jacket material: PE
         b. Outer conductor material: Corrugate copper
         c. Dielectric Material: Foam PE
         d. Flexibility: Standard
         e. Inner conductor material: Copper
         f. Jacket color: Black
      2. Electrical characteristics:
         a. Cable impedance: 50 ohm, ±1 ohm
         b. Capacitance: 23.1 pF/ft
c. Operating band: 1 to 5000 MHz

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Attenuation (dB/100 ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 MHz</td>
<td>0.86</td>
</tr>
<tr>
<td>450 MHz</td>
<td>1.565</td>
</tr>
<tr>
<td>700 MHz</td>
<td>2.007</td>
</tr>
<tr>
<td>800 MHz</td>
<td>2.166</td>
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</table>

B. Surge arrester, lightning protector:
1. Flange mounted, single transmitter coaxial lightning protection for 400 MHz to 1200 MHz with N type, female connectors
2. Mount type: Flange mount
3. Standards: CE compliant, RoHS compliant
4. Frequency range: 400 MHz to 1200 MHz
5. Protected side connector: N type, female
6. Surge side connector: N type, female
7. Turn On Voltage: 600 Vdc ± 20%
8. VSWR: ≤1.1:1 over frequency range
9. Insertion loss: ≤0.1 dB over frequency range

2.05 Service Antenna Infrastructure

A. Indoor coaxial cable
1. Coaxial Cables - Air dielectric, plenum rated coaxial cable, low PIM, corrugated aluminum coaxial cable, off White PVDF jacket
2. Material characteristics:
   a. Jacket: PVDF
   b. Outer Conductor material: Corrugated Aluminum
   c. Dielectric material: PE Spline
   d. Inner conductor: Copper clad aluminum wire
   e. Jacket color: Off-White
3. Electrical characteristics:
   a. Impedance: 50 Ohm
   b. Frequency band: 1 to 6000 MHz
4. Mechanical characteristics:
   a. Bending moment: 5.0 ft lb
   b. Fire retardancy test method: NFPA 262/CATVP/ CMP
   c. Minimum bending radius, single bends: 2.50 inch
   d. Tensile Strength: 175 lb
5. Electrical Performance:

<table>
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<tr>
<th>Frequency</th>
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<tbody>
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<td>150 MHz</td>
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</tr>
<tr>
<td>450 MHz</td>
<td>1.565</td>
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</table>
B. Indoor coaxial cable – (If garage exists)
   1. The garage areas will require the cable to be run in conduit and the conduit to be in the slab. This will require a maximum conduit size of 3/4” and will require a flexible, smaller diameter cable to be used.
   2. Coaxial Cables – Flexible Low Loss Plenum Coax
   3. Material characteristics:
      a. Jacket: Fluoropolymer
      b. Outer Conductor material: Aluminum Tape
      c. Dielectric material: Low density PTFE
      d. Inner conductor: Solid BCCAl
      e. Jacket color: Red
   4. Electrical characteristics:
      a. Impedance: 50 Ohm
      b. Frequency band: 1 to 6000 MHz
   5. Mechanical characteristics:
      a. Bending moment: 5.0 ft lb
      b. Fire retardancy test method: NFPA 262/CATVP/ CMP
      c. Minimum bending radius, single bends: 2.50 inch
      d. Tensile Strength: 175 lb
   6. Electrical Performance:

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<td>2.007</td>
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<tr>
<td>800 MHz</td>
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</tbody>
</table>

5. Indoor Antennas
   1. Omni-directional and directional panel coverage antennas shall feature a multi band design, accommodating multiple frequency bands in a single antenna.
   2. Performance criteria:
      a. Frequency range: 698–960 MHz, 1710–2700 MHz

6. Couplers, Splitters and Combiners
   1. All directional couplers, splitters and combiners must be able to handle 698-960MHz systems.

PART 3 EXECUTION
3.01 Examination
A. Contractor shall thoroughly examine Project site conditions for acceptance of DAS installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.02 Installation
A. Install equipment in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.
B. Active equipment to be located in a 2-hr rated room unless otherwise directed by the AHJ.
C. 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.
D. Locate equipment, antennas and splitters at locations shown on the shop drawings.
E. Install cabling, connectors, and splitters in a neat and orderly manner per the routing indicated on the shop drawings. Support cabling in compliance with CEC and manufacturers recommendations.
F. Maintain a 6” minimum distance between the DAS cabling and other cabling for parallel runs. Do not install coaxial cabling open in any areas were the cabling will subject to physical damage.
G. ERRCS cabling shall be in installed in a conduit system unless approved by SUFMO. All vertical risers shall be installed within a 2-hour rated shaft type enclosure.
   1. Horizontal cabling shall meet level 1 survivability with acceptable conduit type of EMT or flex.
H. Grounding per local and national electric codes and/or Motorola R-56 standards.
I. All cables, boxes, splitters, antennas shall be provide an approved label
J. Permanent approved signage shall be provided on all doors where ERRCS equipment is installed.

3.03 Equipment Mounting
A. Install wall mounted equipment enclosures in spaces as indicated on shop drawings in accordance with manufacturer’s instructions and seismic requirements.
B. Install head end equipment rack in equipment space indicated on the shop drawings. Fasten to the floor per manufacturer’s instructions and provide seismic bracing as required in compliance with Codes.
C. Install donor and service antennas per details shown on the shop drawings.

3.04 Field Quality Control
A. Refer to Specification Section (Electrical Commissioning)
B. Manufacturer’s field service: Contractor shall arrange and pay for the services of a factory-authorized service representative to supervise the initial start-up, testing and adjustment of the equipment or qualified personnel.
C. Independent testing: Owner will contract out initial 3rd party testing. Any additional testing due to failures will be contracted by the owner and paid for by the installing contractor. Testing Agency
to perform all quality control electrical testing, calibration and inspection required herein. Independent Testing Agency shall meet the requirements as outlined in NFPA1221 2019 Chapter 9.

D. Assure equipment installation conforms to specified requirements and operates within specified tolerances.
E. Field test and inspect to insure operation in accordance with Manufacturer’s recommendations and Specifications.
F. Prepare final test report including results, observations, failures, adjustments and remedies, and document all settings and configurations as required by CFC, NFPA 1221, and local jurisdiction.
G. Apply label on switchboard upon satisfactory completion of tests and results.
H. Verify ratings and settings and make final adjustments.
I. At least three weeks prior to any testing, notify the 3rd Party Tester and SUFMO representative so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the 3rd Party Tester’s witnessed test.

3.05 Testing

A. System validation procedure:
   1. Test location:
      a. Each antenna per floor will be tested to meet the expected link budget for each band as per design.
      b. Downlink received signal level measurements will be recorded in the coverage area using a CW test signal. Measurements will be collected using a calibrated spectrum analyzer and a dipole antenna.

B. System Acceptance testing
   1. Test Location:
      a. Each floor of the building will be divided into 20 equal grids.
      b. Each grid will be tested at the approximate center, the locations shall represent the entire grid.
      c. Failure of a maximum of two non-adjacent test areas shall not result in failure of the test.
      d. In the event that three of the test areas fail the test, in order to be more statistically accurate, the floor shall be divided into 40 equal test areas. Failure of a maximum of four non-adjacent test areas shall not result in failure of the test. If the system fails the 40-area test, the system shall be altered to meet the 90% coverage.

C. Equipment requirements:
   1. Test equipment shall be allowed to stabilize in test environment prior to calibration for a minimum of thirty minutes. Any change in temperature can void the calibration.
   2. Signal generator for CW testing must be connected to the head end downlink (TX) interface via tested and approved coaxial cabling and connectors.
   3. Signal generator transmits frequency (MHz) and power (dBm) must be determined by link budget from the donor antenna through the BDA amplification and must be performed for each band and BDA.
   4. Verify that all remote units for the area under test are ON.
   5. Test frequency and power must be recorded corresponding to the date and time of each site walk measurement.
   6. Spectrum analyzer with unity gain (0dB, frequency specific) dipole receive antenna must be preapproved by the project engineer.

D. Documentation:
   1. Exact location of measurement must be marked on the grid print.
2. Signal strength, frequency span and avg channel power must be recorded for each location.

3. In the event that the system fails to function properly during the testing as a result of inadequate pretesting or preparation, the Contractor shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence and the Engineer's hourly rate.

4. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.

5. Contractor shall submit the Testing Agency's final report for review prior to Project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies and remedies. Test report shall be included in the operation and maintenance manuals.

6. Final Record “As-Built” drawings, calculations and product data approved by SUFMO to be filed with Maps & Records with hard copies in the building Document Box at the ERRCS panel.

3.06 Training
   A. Refer to Specification Section (Electrical Commissioning)
   B. Factory authorized service representative shall conduct a training seminar for Owner's Representatives upon completion and acceptance of system. Instructions shall include safe operation, maintenance and testing of equipment with both classroom training and hands-on instruction.
   C. Contractor shall schedule training with a minimum of 7 days advance notice.

3.07 Signage
   A. 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 attachments for size, shape and color of signage.
   B. All ERRCS active equipment rooms to have signage posted.

END OF SECTION
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<th>Rx</th>
<th>System Name</th>
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<td>774.40625</td>
<td>804.40625</td>
<td>(SVRIA) P25 Phase II Digital Radio System</td>
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<td>5</td>
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<td>*System shall have the capability to support a minimum of 24 channels</td>
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