City of Lompoc, CA

Request for Proposals

Functional Specifications

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1. Functional Specifications

The Request for Proposals (RFP) functional specifications describe the general, functional, and operational requirements of the desired system. While not a design, these specifications provide requirements for system architecture and performance including coverage, capacity, reliability, and interoperability. It also describes the key components of the System including the radio network, control equipment, dispatch consoles, backhaul network, subscriber units, and warranty support.

The term “City” refers to the City of Lompoc, CA.

The term “System” refers to the new ultra-high frequency (UHF) land mobile radio (LMR) system.

The term “Contractor” refers to the prime contractor awarded this project and all subcontractors hired by the prime contractor.

All requirements apply equally to the prime contractor and all subcontractors, which are referred to as Contractor throughout the rest of this section.

Specifications designated as OPTIONAL require a response but will not obligate the City to purchase the good or service although the City may seek to include additional service types under the contract where it makes both technological and financial sense.

1.1 Overview

1.1.1 Current System

A. The City current system is UHF and VHF analog conventional system with:
   1. Over 500 subscriber units
   2. 6 Fixed Repeated Sites
   3. 1 Control/Dispatch Site with 2 radio consoles
   4. 1 Receiver Site
   5. 11 UHF Repeated Channels (Also several talk around channels and several monitored)
   6. 2 VHF Repeated Channels (Also one talk around channel and one airport channel)

B. Departments that use the Citywide LMR system include:
   1. Public Safety
      a. Police
      b. Fire

2. Local Government (LG)
    a. Community Development
        1) Parks
        2) Recreation
    b. Utilities
        1) Electric
        2) Solid Waste
        3) Water
        4) Wastewater
    c. Public Works
        1) Engineering
        2) Facility Maintenance
        3) Fleet
        4) Streets
        5) Transit
        6) Urban Forestry

C. The radio system, dispatch consoles, and majority of subscriber equipment have reached the end of their manufacturer-supported lifecycle and guaranteed parts and support. The City requires replacement of this equipment with standards-based, public safety system and subscribers.

1.1.2 Future System

A. A new radio system shall replace the existing analog UHF radio systems used by the Police Department and Local Government, Community Development, Utilities, and Public Works.

B. The System shall be designed to support City departments/agencies listed in Section 1.1.1.B, except Fire. The System shall include:

1. Standards based Project 25 (P25) Phase 1 Trunking radio system, upgradeable to P25 Phase 2 Trunking, that leverages existing City licensed frequencies and available UHF spectrum
2. Re-use of existing City owned or occupied sites and infrastructure (towers, buildings, shelters, equipment rooms, power sources) where possible, with site improvements where needed

3. Dispatch consoles, with backup control stations, and integration with or upgrades to the City's existing logging recorder, and interface to the City's existing computer aided dispatch (CAD) system
4. Backhaul network leveraging existing connections where possible and replacing and/or adding new digital microwave hops providing connectivity between the system control equipment, dispatch consoles, and radio sites selected for the design
5. Integrated Network Management System (NMS) capable of monitoring and controlling above systems
6. Subscriber units (portable, mobile, and control station radios), with department-specific quantities and capabilities
7. Mobile Command Post equipment leveraging City-supplied vehicle and backhaul connectivity for a single P25 Conventional channel

C. The UHF radio system shall be equipped and licensed for low-speed data capability to integrate existing supervisory control and data acquisition (SCADA) systems.

D. Contractor shall furnish all labor, materials, and other related items to install, test, and maintain the System and related equipment in compliance with the requirements described and referenced in this document.

E. The System shall be fault tolerant and contain no single point of failure that would disrupt communications.

F. The System shall provide mobile and portable on-street radio coverage throughout the service areas described in Section 1.2.3.

G. Contractor shall not use existing LMR system(s) to meet the coverage requirements. Contractor shall furnish all new LMR equipment.

H. Contractor shall re-use existing site infrastructure to the extent possible, pending site survey results (to be conducted between contract award and prior to Detailed Design Review) and approval by the City.

I. The existing City radio and backhaul equipment shall support operations during the implementation and testing of the System equipment.

J. Contractor may propose a phased implementation. Contractor shall execute the implementation per phase based on a City-approved Implementation Plan, Acceptance Test Plans, and Migration/Cutover Plan.

K. As an OPTION, a new radio system shall replace the existing analog very high frequency (VHF) radio system used by the Fire Department.

L. As an OPTION, Contractor shall replace the existing analog VHF radio system equipment at existing sites on a 1-for-1 basis.

1.1.3 Standards and Guidelines

A. Contractor shall comply with the applicable portions of the following standards, rules, regulations, and industry guidelines (presented here in alphabetical order; not reflective of priority):

1. American National Standards Institute (ANSI)
2. American Society of Testing Materials (ASTM)
3. Federal Aviation Administration (FAA)
4. Federal Communications Commission (FCC)
5. Institute of Electrical and Electronics Engineers (IEEE)
6. International Building Code (IBC)
7. NFPA 70®, National Electrical Code® (NEC®)
8. National Electrical Manufacturer's Association (NEMA)
9. National Fire Protection Association (NFPA) 1221
10. Telecommunications Distribution Methods Manual (TDMM)
11. Telecommunications Industry Associations (TIA)
12. Underwriters Laboratories, Inc. (UL)

B. At a minimum, the System shall comply with one of the industry best practices for system installation, grounding, bonding, and transient voltage surge suppression (TVSS), as outlined in the following standards (presented here in alphabetical order; not reflective of priority):

1. ANSI/TIA-607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises, latest revision
2. AE/LZT 123 4618/1 Site Grounding and Lightning Protection Guidelines, latest revision
3. MIL-STD-188-124B - Grounding, Bonding, and Shielding for Common Long Haul/Tactical Communications Systems Including Ground Based Communications-Electronics Facilities and Equipment
4. Motorola Solutions R56 Standards and Guidelines for Communication Sites, latest revision

1.1.4 Network Security Requirements

A. Contractor shall comply with the following security standards and industry guidelines, provided below which are not weighted in order or priority:

1. FIPS PUB 140-2: Security Requirements for Cryptographic Modules
2. ISO/IEC 27000:2018: Information Technology – Security Techniques – Information Security Management Systems – Overview and Vocabulary
3. ISO/IEC 27001:2013: Information Technology – Security Techniques – Information Security Management Systems – Requirements
4. ISO/IEC 27002:2013: Information Technology – Security Techniques – Code of Practice for Information Security Controls
5. ISO/IEC 27005:2018: Information Technology – Security Techniques – Information Security Risk Management
6. ISO/IEC 27010:2015: Information Technology – Security Techniques – Information Security Management for Inter-Sector and Inter-Organizational Communications
7. ISO/IEC 27031:2011: Information Technology – Security Techniques – Guidelines for Information and Communication Technology Readiness for Business Continuity
8. ISO/IEC 27032:2012: Information Technology – Security Techniques – Guidelines for Cybersecurity
9. ISO/IEC 27033-1:2015: Information Technology – Security Techniques - Network Security
10. ISO/IEC 27035-1:2016: Information Technology - Information Security Incident Management – Part 1: Principles of Incident Management
11. ISO/IEC 27035-2:2016: Information Technology - Information Security Incident Management – Part 2: Guidelines to Plan and Prepare for Incident Response
12. ISO/IEC 27035-3:2020: Information Technology - Information Security Incident Management – Part 3: Guidelines for ICT Incident Response Operations
13. ISO/IEC 27039:2015: Information Technology – Security Techniques - Selection, Deployment, and Operations of Intrusion Detection and Prevention Systems (IDPS)
14. ISO FCAPS: Fault management, Configuration management, Accounting management, Performance management, Security management

15. ITIL Version 3, Service Design, Section 4.6: Information Security Management

B. Routing and switching equipment shall employ Open Systems Interconnection (OSI) model Layer 2 and Layer 3 security best practices to minimize different types of attacks on the data link layer and to filter network traffic on the network layer.

C. The System shall utilize secure protocols for network management, configuration, alarms, and events.

D. Contractor shall work with the City to supply, install, and configure virtual private network (VPN) hardware and software using two-factor authentication for access to allow multiple levels of remote secure access of system radio frequency (RF) and control infrastructure equipment.

E. Contractor shall supply, install, and configure firewall protection system(s) and intrusion detection system(s).

F. Contractor shall supply, install, and configure anti-virus and anti-malware software on all supplied servers and workstations. Anti-virus and anti-malware software shall include all definition updates during the warranty period.

G. Contractor shall provide and install software patches for all supplied commercial off the shelf products during the warranty period. The System patches provided shall be no more than one version than the software original equipment manufacturer (OEM) releases. All patching shall be pull initiated by the new system through firewall.

H. The System backhaul links shall support payload encryption.

1. At a minimum, payload encryption shall be fully compatible with AES and comply with FIPS-197.

2. The AES algorithm shall support 128-bit or 256-bit symmetric keys, via a randomly generated encryption combination.

I. The System shall be designed for secure management of the radios and other required equipment by the NMS.

J. The System shall be compliant with the International Telecommunications Union’s ITU-T x.805 Security Architecture.

K. Network devices shall support the following security dimensions:

1. Access control

2. Authentication

3. Non-repudiation

4. Data confidentiality
5. Communication security
6. Data integrity
7. Availability
8. Privacy

L. Any network port or device interface that is not used at the time of system implementation shall be software configured to be disabled. A list of all disabled ports; by site, equipment designation, and port designation shall be delivered as part of the System documentation package.

M. The City will supply the Contractor with IP addressing information.

1.1.5 Governing Codes and Conflicts

A. If the requirements of this RFP differ with those of the governing codes and regulations, then the more stringent of the two shall apply.

B. If the requirements of this RFP conflict with those of the governing codes and regulations, the Contractor is responsible for identifying the conflict and resolving to the satisfaction of the City.

1.2 Project 25 Radio System

1.2.1 P25 Requirements

A. The System shall comply with applicable TIA-102 (P25) standards as published at the time of proposal. If revised or new TIA-102 standards are published after the proposal date that affects the designated system components, the Contractor shall work with the City to determine an agreeable solution to be compliant with the revised or new standards.

B. The System shall support P25 Phase 1 Conventional mode using Frequency Division Multiple Access (FDMA) 12.5kHz channels.

C. The System shall operate in P25 Phase 1 Trunking mode using FDMA 12.5kHz channels.

D. The System shall provide a P25 technology solution capable of operating with all P25 Compliance Assessment Program (CAP) compliant radios.

E. The System shall be upgradeable to P25 Phase 2 Trunking operation. Contractor shall describe hardware and/or software upgrades needed for system control, radio sites, dispatch consoles, and subscriber units.

1.2.2 System Control

A. The System shall meet or exceed the following System control requirements:

1. System control equipment may utilize centralized or distributed architecture.
2. System control equipment shall be fault tolerant with no single point of failure.
3. System control equipment shall have localized high availability so that failure of a single System control component does not reduce System functionality.

B. If centralized architecture is proposed, Contractor shall offer OPTIONAL System control equipment with redundant components located at geographically separate locations.

C. If centralized architecture is proposed, Contractor shall offer OPTIONAL cloud-based System control equipment as the backup or secondary control location.

D. The System shall provide the following features and capabilities:

1. Push-To-Talk Identification (PTT-ID)
2. Group Call
3. Private call
4. Call alert/paging function
5. Emergency alarm/alert function
6. Voice prioritization over data
7. User and talkgroup priority levels
8. Transparent site roaming (automatic intra-system roaming)
9. Radio enable/disable function
10. Out of range indication
11. Dynamic Regrouping
12. Text messaging using subscriber radios
13. Unit Location Services
14. Advanced Encryption Standard (AES)
15. OPTIONAL Over-the-air rekeying (OTAR)
16. OPTIONAL Over-the-air programming (OTAP)

E. The System shall be equipped and licensed for 256-bit Advanced Encryption Standard (AES) encryption services (including consoles and logging recorders) compliant with current P25 requirements.

F. The System shall be designed with no critical single points of failure. Any network element critical to normal operation shall be redundant. Such elements include, but are not limited to:

1. System control equipment
2. Site control equipment
3. Simulcast control equipment
4. Voting comparators
5. Critical routers
6. Critical switches and gateways
7. Backhaul network
8. Power systems
9. Critical HVAC systems
10. Humidity and temperature sensors

G. The System shall be capable of automatic activation of failure modes in the event of a failure beyond a single point.

H. The following Critical failures should invoke the activation of a failure mode without preventing wide-area or local communications:

1. Loss of System control activity
2. Loss of simulcast control activity
3. Loss of one or more voting comparator
4. Loss of one or more sites and/or link connectivity
5. Loss of one or more channels
6. Loss of one or more dispatch consoles

1.2.3 Coverage

1.2.3.1 System Coverage Requirements

A. Delivered Audio Quality (DAQ) as defined in this document applies to both talk-in and talk-out communications. Table 1 lists DAQ values and definitions.

Table 1 – DAQ Values and Definitions

DAQ	SUBJECTIVE PERFORMANCE DESCRIPTION
1	Unusable, Speech Present, but unreadable
2	Understandable with considerable effort. Frequent repetition due to noise/distortion
3	Speech understandable with slight effort. Occasional repetition required due to noise/distortion
3.4	Speech understandable with repetition only rarely required Some noise/distortion
4	Speech easily understood. Occasional noise/distortion
4.5	Speech easily understood. Infrequent noise/distortion
5	Speech easily understood

B. Unless otherwise specified in this document, the coverage design, implementation, and testing for the System shall adhere to Telecommunications Systems Bulletin (TSB) TSB 88 – Wireless Communications Systems Performance in Noise and Interference-Limited Situations, current version.

C. Contractor shall use the shapefiles provided in Appendix A (for importing the service area into a coverage analysis modeling tool) as the service area for mobile and on-street operation.

D. The UHF radio system shall provide on-street coverage for 95% of the service area at 95% reliability and DAQ of 3.4 to a portable radio worn at hip level in a belt case. The 5% that does not meet the above RF coverage levels shall not all be in one location. This requirement shall also apply for mobile radios.

E. The UHF radio system shall provide in-building coverage at DAQ of 3.4 to a portable radio worn at hip level in a belt case. In-building coverage must be guaranteed and provided by Contractor for the following buildings:

1. Lompoc Valley Medical Center –1515 E Ocean Ave, Lompoc, CA 93436
2. Lompoc City Landfill – 700 Avalon St, Lompoc, CA 93436

F. Using the constellation of existing VHF Fire sites, the Contractor shall describe the guaranteed talk-in and talk-out coverage that the OPTIONAL new system will provide to a mobile and portable on-street worn in turnout gear, with 95% reliability and a DAQ of 3.4 or better within the City service area.

G. Portable radio coverage requirements for the UHF radio system shall be met by assessing a portable radio worn at the hip (i.e., approximately 3 feet above

ground level), inside a belt case, with a remote speaker mic (RSM) accessory. The ½ wave antenna shall be simulated as being at hip-level for both talk-in and talk-out communications. Body loss factors for portable radio performance shall comply with the current version of TSB.88-1 Table D 5.

H. Portable radio coverage requirements for the OPTIONAL VHF radio system shall be met by assessing a portable radio worn in turnout gear at shoulder level. Recommendation is to use an antenna loss factor of 12 dB to simulate for portable radio performance in turnout pocket operation.

I. Mobile radio coverage requirements (UHF and VHF) shall be met by assessing a trunk or dash mounted mobile radio with a **3 dBd gain** mobile antenna, mounted in the center of the vehicle roof at a height of six feet above ground level. Any antenna derating factors for mobile radio performance shall comply with the current version of TSB.88-1 Table D 3.

J. Vehicular repeaters may be used to supplement portable radio coverage but not to meet the primary coverage requirements.

1.2.3.2 Coverage Acceptance Testing

A. The following steps shall be required after all sites providing coverage for each System channel are ready for testing.

B. Contractor shall complete coverage testing of the System with witnesses from the City and/or City's representative, utilizing Bit Error Rate (BER) testing. Contractor shall submit appropriate documentation confirming lab testing of the Bit Error level for the portable radio, which will yield the equivalent of a DAQ 3.4 audio quality. Likewise, the Contractor shall test the System to that level.

C. Contractor shall perform Coverage testing in both the talk-out and talk-in directions.

D. Contractor shall complete coverage testing of the System with witnesses from the City and/or City's representative, utilizing non-automated, subjective DAQ testing.

E. The City and/or City's representative will observe and monitor the entire coverage testing process. For test purposes, the Contractor shall divide the service areas into grids and test both the System according to Section 5.12.

F. Contractor shall provide a detailed coverage analysis study and provide coverage parameters and maps specified in Section 1.2.3.1.

1.2.3.3 Link Budgets

A. Contractor shall provide detailed link budgets for each radio site in their design. These link budgets shall include all pertinent technical parameters relating to signal losses and gains and shall include how the calculated received signal levels will correspond to a DAQ of 3.4, with the 95% service area reliability requirement, as defined by the current version of TSB-88.

B. Values presented in the link budgets shall include, but not be limited to, the following:

1. Static sensitivity for mobile and portable radios (dBm), and corresponding SINAD (analog) and/or BER (digital) performance
2. Statistical distribution assumed for multipath fading (Rayleigh, Okumura-Rice, etc.)
3. Fading factor (dB) and statistical assumptions (log-normal fading, etc.) used to account for location variability (i.e., adjustment from median required signal level in a given coverage sector or grid segment that were used to model reliable operation at 95% of the locations in that sector or grid segment).
4. Transmit/receive antenna mounting height (AGL)
5. Transmit/receive antenna gain (dBd)
6. Transmit/receive antenna down tilt (degrees)
7. Transmit/receive antenna azimuth (degrees)
8. Transmit site effective radiated power (ERP)
9. Gains and losses of all components throughout the transmit/receive antenna systems (dB)
10. Receiver Multi-Coupler Net Gain (dB)
11. Receiver Multi-Coupler Noise Figure (dB)
12. Mobile radio antenna system net gain (dB)
13. Mobile radio transmitter output power (dBm)
14. Portable radio antenna system net gain (or loss), including body losses for hip-level operation in belt case per Table D-5 of current version of TSB-88
15. Portable radio transmitter output power (dBm)
16. Assumptions regarding talk-out and talk-in path balance (i.e., any imbalance between talk-out and talk-in shall be stated and explained).
17. Launch delays (microseconds) if used, for all simulcast sites

18. Tower-top amplifier gain (dB)

1.2.3.4 Coverage Maps

A. Contractor shall submit talk-in and talk-out coverage prediction maps for the System. Coverage maps shall be provided for each of the following transmission paths, using antenna configurations described in Section 1.2.3.1:

1. Mobile Radio Talk-in (composite and individual sites)
2. Mobile Radio Talk-out (composite and individual sites)
3. Portable Radio Talk-in, on-street (composite and individual sites)
4. Portable Radio Talk-out, on-street (composite and individual sites)
5. Portable Radio Talk-in, in-building (composite with 15 dB building loss)
6. Portable Radio Talk-out, in-building (composite with 15 dB building loss)

B. All maps shall clearly delineate the difference between areas predicted to be equal to or greater than DAQ 3.4 equivalent coverage and areas that do not meet coverage requirements.

C. For all mapping configurations described above, Contractor shall provide “composite” coverage maps, which represent the effective coverage of all simulcast cells and/or multicast sites. In addition, Contractor shall provide individual simulcast cell coverage maps. These individual simulcast cell maps shall display any areas of predicted time-delay interference (TDI) that are not eliminated through the use of antenna design and/or launch delays.

D. Coverage maps shall be based on the type and tier of subscriber equipment provided by Contractor, utilizing the same type of antennas being provided with the required subscriber radios.

E. Contractor shall describe the RF propagation model (including version number, if applicable) used to provide coverage predictions.

F. Contractor shall describe the terrain and clutter dataset resolution used to perform coverage predictions. At a minimum, these datasets should have a resolution of 30 meters.

G. The coverage maps shall be provided in a scale such that all areas with less than 95% reliability are easily spotted during the review of such maps.

H. Contractor shall include coverage statistics that clearly delineate the predicted coverage percentages for all required transmission paths (i.e., portable on-street talk-in), for all service areas as described in Section 1.2.3.1.

I. Coverage maps shall be provided in the following formats:

1. In PDF file format with an image resolution greater than 600 dpi when printed at 11”x17” on a flash drive
2. In a computer file format that may be imported into the City’s ESRI ArcGIS system.
3. In a computer file format that may be imported into Google Earth Pro (e.g., KML, KMZ).

J. All maps shall include map layers suitable for the City’s reference (e.g., topographic map, roads, rivers, etc.).

1.2.4 Site Selection

A. The City prefers the reuse of existing sites where possible. The City prefers the following priority for site selection:

1. Existing City-owned sites
2. Existing County-owned sites
3. Other existing public safety and/or government radio sites
4. Leased (commercial carrier) sites
5. Greenfield sites

B. Contractor shall evaluate the following potential / candidate sites, in order of City preference, for coverage design:

1. Flagpole Hill
   a. Latitude: 34 40 27.9 N
   b. Longitude: 120 27 31.3 W
2. Hancock College Emergency Training Building
   a. Latitude: 34 40 45.7 N
   b. Longitude: 120 27 42.0 W
3. Hancock College Maintenance Building
   a. Latitude: 34 40 43.9 N
   b. Longitude: 120 27 43.5 W
4. Ken Adams Park
   a. Latitude: 34 40 48.32 N
   b. Longitude: 120 27 30.24 W
5. River Park

a. Latitude: 34 39 1.45 N

b. Longitude: 120 26 3.28 W

C. Contractor shall choose all other sites necessary to provide the required coverage.

1. Contractor shall consider City owned or currently leased sites but is not obligated to use them in their design. All existing site information shall be verified by the Contractor.
2. If the Contractor utilizes a site or sites currently in use by the City, they shall conduct mandatory site visits at those sites once under contract and notify the City of any site modifications necessary.
3. If the Contractor utilizes a site or sites currently in use by the City, the City will provide documentation once under contract for all existing site information available. Any missing information shall be collected by the Contractor during site surveys.
4. If the Contractor selects sites owned by others, the Contractor shall conduct due diligence following issuance of Intent to Award and provide a letter from the site owner(s) that state the following:
   a. The owner is willing to lease space at the site to the City, including the lease rate offered.
   b. Space is available on the tower at the Contractor defined heights, and space is also available for equipment in an existing room, or space is available for a shelter to be placed within the secured site area.
5. If the City does not accept the lease rate and/or contract requirements at sites owned by others, the Contractor shall work with the City to identify other candidate site(s).

1.2.5 Capacity

A. The System shall meet the following system capacity requirements:

1. The System shall utilize trunking technology to maximize spectrum efficiency.
2. The System capacity at the time it is placed into service shall assume 100% P25 Phase 1 FDMA users.
3. The System shall support a Grade of Service (GoS) of less than or equal to 1% with queuing to be no greater than 0.5 seconds.

4. Calculations shall be based on busy hour on a per site basis.

B. Contractor shall disclose all GoS assumptions and calculations to the City for validation including but not limited to number of users, Erlang model, number of available talk paths, projected number of calls made, average call durations, and the number of active subscriber units.

C. The City estimates that approximately 600 subscriber units will be placed into service on the system upon system activation.

1. The System shall provide sufficient capacity to support existing City subscriber counts (based on subscriber inventory in Appendix C).
2. The System shall provide sufficient capacity to support a 1% per year subscriber unit growth over the next 10 years.

D. Contractor shall include the necessary radio system hardware (including antenna RF distribution system) and software (including licenses) to support the projected subscriber units.

E. All control components (hardware and software) shall be expandable to support the following levels of additional capacity. The control components are not required to be equipped or licensed for this expansion as part of the proposed System.

1. At least 25% more simulcast sites than are required to meet the System coverage requirements.
2. At least 25% more multicast sites than are required to meet the System coverage requirements.
3. At least 25% more radio channels than are required to meet the System initial capacity requirements listed above.
4. At least 25% more dispatch consoles than those proposed for the System.
5. At least 1,000 subscriber radios (distinct subscriber radio IDs) and a minimum of 1,000 talkgroups and announcement groups

F. Contractor shall provide a table that identifies the maximum capacity of the following items that the System can accommodate:

1. Simulcast sites
2. Multicast sites
3. Channels
4. Consoles
5. Radios

6. Talkgroups

1.2.6 Site Equipment

A. The site equipment, or RF infrastructure, consists of the following components:

1. Simulcast and/or multicast equipment
2. Receiver voting equipment
3. Transmitters
4. Receivers
5. Combiners/multicouplers
6. Antennas
7. Antenna cabling and grounding systems

B. All supplied electronic equipment shall have monitor/alarm interfaces to provide status to the NMS.

1.2.6.1 Simulcast Equipment

A. Where simulcast is utilized, Contractor shall provide simulcast control equipment or a distributed architecture across the network.

B. As an OPTION for centralized architecture, Contractor shall offer a System that is equipped and configured with geo-redundant simulcast control equipment.

C. Contractor shall provide all necessary simulcast components and signal processing elements required to optimize voice quality in coverage overlap areas.

D. Non-captured overlap areas with delay spreads in excess of those required to meet the DAQ objective shall be minimized inside the service area.

E. Only linear repeaters shall be used.

F. Simulcast equipment shall have launch delays that are set during deployment but do not need to change unless a System design change is made.

1.2.6.2 Receiver Voting

A. Where receiver voting is utilized, the Contractor shall provide trunked voting equipment or distributed across the network.

B. As an OPTION for centralized architecture, Contractor shall offer a System that is equipped and configured with geo-redundant voting equipment.

C. Receiver voting equipment shall monitor all receivers in the simulcast cell and select the best signal for processing and rebroadcast through the network.

D. Receiver voting equipment shall continue to operate in the event of failure of, or lost connectivity with other control elements.

1.2.6.3 Transmitter Equipment

A. Repeater/base radio equipment shall:

1. Be solid state in design and function and shall operate in the temperature range of -20°F - 140°F without degradation.
2. Be provided with mounting configurations for standard relay rack or lockable cabinets.
3. Consist of modular components or field replaceable units allowing for in the field repairs whenever possible.

B. Repeater/base radio equipment shall comply with appropriate Part 90 and Part 15 of the FCC Rules and Regulations.

C. Repeater/base radio equipment shall be FCC type accepted for the appropriate frequency band and type of service.

D. Repeater/base radio equipment shall comply with appropriate TIA 102 and similar standards.

1.2.6.4 Antenna Systems

A. Contractor shall design, supply, and install new antenna system(s) necessary for a complete system design.

B. The antenna system(s) shall meet the following requirements:

1. Provide the required guaranteed coverage
2. Match the antenna design used for all coverage modeling
3. Meet applicable FCC rules and regulations

C. The antenna system(s) shall consist of new TX/RX antenna(s), transmission line, mounting hardware, transmit combiner(s), receive multi-coupler(s), tower top amplifier (TTA) if needed, and lightning protection for each radio site.

D. If the System design includes the use of TTAs, the amplifiers shall be equipped with dual amplifiers, and a by-pass mode of operation.

E. Antennas shall be selected to perform in and endure the anticipated environmental conditions.

1. Tornadoes, high winds, snow, sleet, ice, and heavily forested areas shall be considered.

F. Structural survivability of antennas shall meet specification based on ANSI/TIA-222, latest revision, or the latest revision adopted by the jurisdiction.

G. Transmission line type and length shall be appropriate given the radio band, to provide the required coverage.

1.2.7 Mobile Command Post

A. Contractor shall supply and install new equipment into the City's Mobile Command Post vehicle consisting of the following components:

1. Repeater/base radio equipment that comply with the requirements specified in Section 1.2.6.3
2. Antenna system equipment consisting of new TX/RX antenna(s), transmission line, and mounting hardware suitable for installation on the City's Mobile Command Post vehicle.

B. All supplied electronic equipment shall have monitor/alarm interfaces to provide status to the NMS while in use.

C. The UHF P25 Conventional channel shall be monitored by the Dispatch Control System specified in Section 1.3 and interface directly with the logging recorder specified in Section 1.4 for audio.

1.2.8 Interoperability

A. The radio system shall include interop / conventional channel gateways for interfacing and patching between P25 trunked talkgroups and analog/conventional Mutual Aid channels.

B. The radio system shall provide the City of Lompoc with interoperability capability to talk to Santa Barbara County Sheriff's Office, City of Santa Maria Police Department, Santa Barbara Regional Fire Dispatch, Vandenberg Space Force Base, United States Penitentiary Lompoc (USP Lompoc), EMS/Hospital, and California Highway Patrol.

C. The radio system shall include one Inter RF Subsystem Interface (ISSI) connection allowing interoperability with another P25 radio system.

D. The following features shall be supported between the new system and the ISSI interconnected system:

1. Automatic (hands-free) roaming to both systems
2. Confirmed group call

3. Unconfirmed group call
4. Announcement group call
5. Emergency group call
6. Individual Call
7. Priority call (with and without preemption)
8. AES encryption
9. Call alert
10. Emergency alarm
11. Emergency clear
12. Unit ID

E. The ISSI equipment shall allow a talkgroup from another P25 system that is interconnected to the City system via ISSI to be patched via a console-initiated patch to a talkgroup on the City system.

1.3 Dispatch Console System

1.3.1 General Requirements

A. Contractor shall provide the following quantities of new dispatch consoles that support all current P25 mandatory features.

1. Police Department – 5 consoles
2. Water – 1 console
3. Transit – 2 consoles
4. Solid Waste – 1 console
5. Spare – 1 console

B. Contractor shall provide the City with OPTIONAL pricing for additional radio dispatch consoles.

C. Contractor shall provide one deployable dispatch console for use in a mobile command center.

D. Contractor shall supply all necessary hardware, software and licensing needed for system control equipment to support the dispatch consoles.

E. The dispatch system shall be configured with each console position to provide control of:

1. Radio system talkgroups

2. Paging
3. Fire station alerting
4. Emergency alarms and calls
5. Patching between talkgroups and conventional stations
6. Retaining any existing functionality
7. Text 911 application to the dispatch consoles

F. The dispatch console system shall be capable of:

1. P25 Phase 1 call processing
2. P25 Phase 2 call processing
3. P25 group and individual addressing modes
4. At least one unique identity assigned to an operator position
5. An operator position shall support the capability to affiliate with at least one valid talkgroup
6. An operator position shall have the capability to affiliate with multiple valid talkgroups simultaneously

G. The dispatch console system shall meet all P25 standards including Console Sub-System Interfaces (CSSI). Any CSSI-compliant console product shall interface with the radio system and support P25 mandatory features.

H. The dispatch console system shall support processing of supplementary data messaging to and from field radio units (e.g., text and status indication).

I. The dispatch console system shall support dispatch consoles directly connected to the System via the backhaul/interconnection network.

1. Direct-connect dispatch consoles shall use IP connectivity for all voice, data, control, and parallel console status information.

J. Contractor shall provide a backup RF control station for each dispatch console that maintains dispatch operations in the event of a dispatch system failure and/or backhaul network failure. The backup RF control stations shall:

1. Not be dependent on the primary dispatch console system for operations.
2. Allow users to change channels/talkgroups at dispatch positions without affecting other dispatch positions.
3. Be capable of operation in trunking and conventional modes.
4. Have the capability of initiating a private radio call.

5. Be capable of operating with a 6-wire headset and with a conventional speaker and microphone.

K. New control station antenna system shall be provided where new control stations are to be installed.

L. The dispatch console system shall not contain any single point of failure which would disable more than a single operator position or channel resource.

M. The dispatch console system shall employ redundant hot standby cards, power supplies, controllers, routers, and switches to prevent a single point of failure.

N. The console system shall meet the following requirements:

1. The console system shall allow patching among any combination of:
    a. Telephone line
    b. Non-trunked channel resources in the System
    c. Analog channels
2. Current patching capabilities shall be maintained through migration
3. The console system shall allow the selection of multiple talkgroups and/or multiple conventional channels or any combination of these resources
4. The console system shall provide the ability to hear field units while dispatch operators transmit

O. The dispatch console system shall support dispatch and control of any analog or conventional systems that will continue to operate in the City.

P. The dispatch console system shall meet the following conventional requirements:

1. The System shall include interoperability / conventional channel gateways for interfacing and patching between P25 trunked talkgroups and analog / conventional Mutual Aid channels
2. The System shall have the ability to enable or disable the repeat function of any conventional repeaters equipped to do so
3. The System shall allow the selection of the desired transmit frequency or mode on each conventional base station or repeater capable of operating on multiple frequencies or modes
4. The System shall support up to 20 additional channels that are designated for communications with outside agencies, including existing VHF mutual aid channels

Q. Dispatch consoles shall be integrated with existing phone systems to allow for single headset use between radio and telephony.

R. The City's computer aided dispatch (CAD) server is currently being replaced. The new dispatch system shall provide an OPTIONAL application programming interface (API) for integration with the radio system.

1.3.2 Operator Equipment Requirements

A. Contractor shall provide dispatch operator equipment that meets or exceeds the following requirements:

1. All dispatch console equipment supplied shall operate 24 hours a day, 7 days a week, 365 days a year.
2. Contractor shall provide a display monitor with 20” or larger touchscreen LCD/LED with resolution of 1920 x 1080 or better.
3. Console shall be capable of displaying all dispatching functions on a single display unit.
4. Console shall allow authorized personnel to determine which functions are available at each operator position.
5. Console shall provide an individual unit ID and text alias readout for calling units and a stacking display to reflect at least the last ten unit calls for the visible channels/talkgroups.
6. Console position keyboard interface shall be compatible with standard PC USB 2.0 keyboards.
7. Console dispatch position shall be fully functional using a standard 101-key PC keyboard.
8. Operators shall be able to perform console functions by positioning a screen pointer (cursor) over the appropriate icon and pressing the mouse button or by touching the monitor screen.
9. Console dispatch position mouse/pointer interface shall be compatible with standard PC USB 2.0 pointer devices.
10. Console dispatch position shall be fully functional using a standard 2-button PC mouse.
11. Each maintenance console and each deployable console shall have a desk microphone.
12. Each operator position shall have a heavy-duty footswitch to allow operators to key the selected channel hands free.
13. All computers supplied shall be based on current production processors.

14. All computers supplied shall include a currently supported operating system.
15. All computers supplied shall be certified for the latest released version of operating system available at the time of acceptance.
16. The City reserves the right to specify or supply the computer platform(s) in accordance with their IT standards.
17. The failure of one or more console positions should have no effect on the remaining console positions.
18. Equipment shall enable operators to acoustically cross-mute channels to eliminate acoustic feedback between operators.
19. Equipment shall have the ability to decrypt and encrypt secure voice communications. A distinctive icon shall signify encrypted channels.
20. Each operator position shall have the ability to utilize wired and/or wireless headsets for transmitting and receiving audio.
21. Each operator position shall support headsets capable of both telephone and radio use.
22. The dispatch console system shall provide an instant recall recording capability for each operator position.
23. Instant recall recording shall provide an interface to provide connection to the console operators' microphone audio, the selected radio channel receiver audio and telephone audio.
24. Playback shall be available on the operator position.
25. Console System shall have capability to update individual radio unit aliases.
26. Each operator position shall have the ability to initiate and transmit three different types of alert tones.

B. Conventional resources (e.g., repeaters, base stations, and control stations) capable of operating on multiple frequencies and/or modes shall be reconfigurable to select the desired transmit frequency / mode (select channel).

C. An audio level meter shall be provided showing the level of transmitted voice.

1. The audio level meter shall also indicate the level of receive audio present on the selected channel/talkgroup.

D. Operator positions shall have the ability to independently set each channel/talkgroup volume level.

1. Minimum audio levels should be capable of being set to avoid missed calls.

E. Operator positions shall have the ability to mute or un-mute audio from unselected channels/talkgroups.

1. The operator's monitor shall indicate muted audio status.

F. Selected audio and unselected audio shall be presented from separate speakers.

G. Operator positions shall have the ability to select multiple channels/talkgroups for broadcast to several channels/talkgroups at once.

H. Operator positions shall have the ability to patch two or more conventional resource channels/talkgroups so that users may communicate directly.

I. Operator positions shall be equipped such that a minimum of eight simultaneous patches shall be available.

1.3.3 Emergency Alarm Requirements

A. Dispatch consoles shall respond appropriately to the activation of an emergency alarm by field units.

B. Dispatch consoles shall provide an audible alert, provide a visual alert of an emergency activation (on monitor screen and/or strobe light), and display unit ID of calling unit.

C. Dispatch consoles shall have the ability to initiate and cancel a Channel Marker, which is an audible tone that informs radio users that a talkgroup or conventional channel is involved in an emergency call.

D. Dispatch consoles shall have the ability to activate or deactivate a status indicator light when the Channel Marker is initiated or canceled, respectively.

E. Dispatch consoles shall have the ability to acknowledge the emergency alarm.

F. The unit ID and alias for an unacknowledged emergency alarm shall not scroll from the unit ID display.

1.3.4 Configuration Requirements

A. The dispatch console shall support new features and screen configurations through software programming and not reconfiguration of hardware.

B. The dispatch console shall support the capability to program, store, retrieve, and edit multiple, custom operator screens and configurations for each operator position.

C. Operator positions display configurations and alias database shall be stored locally, at each position, or on a centrally located server.

1.3.5 Headset Requirements

A. Two headset jacks, configurable for 4-wire or 6-wire, shall be provided for each dispatch operator position; they shall allow the operator to hear select audio via a headset and allow the operator to respond via a microphone attached to the headset.

1. Each headset jack box shall have volume knobs to control the received radio and telephone volumes.
2. A headset plug inserted into the jack shall automatically disconnect the console's microphone and mute the consoles select speakers.

B. One wired headset shall be provided for each dispatch operator position, and it shall allow the operator to hear select audio via a headset and allow the operator to respond via a microphone attached to the headset.

1.4 Logging Recorder System

A. The radio system shall integrate with City's voice logging recorder provided by Eventide system for recording of all City Police Department and Fire/EMS traffic expected on the new radio systems.

B. The order of preference for the City logging recorder is as follows:

1. Integrate new radio system with existing logging recorder to record radio traffic
2. If existing logging recorder can record the System digital talkgroups, and can be upgraded, then upgrade the recorder with the required number of additional channels
3. If existing logging recorder will not record the System digital talkgroups, and cannot be upgraded, replace the existing logging recorder with new logging recorders

C. If replacement of existing logging recorder is required, Contractor shall comply with replacement requirements specified in Sections 1.4.1 through 1.4.9.

1.4.1 Replacement Requirements

A. If existing logging recorder cannot be used to record the new System traffic and cannot be upgraded to record the new System traffic, Contractor shall propose a

new logging recorder to record the new System, existing analog resources, current 9-1-1 and administrative phone traffic, and planned NG9-1-1 content.

B. Contractor shall supply, install, and configure an IP-based networked P25 compatible, digital logging recorder system.

C. The logging recorder shall meet or exceed all applicable FCC, IEEE, TIA and APCO standards.

D. This logging recorder shall provide the ability to log/record the following:

1. P25 Conventional radio traffic
2. P25 Phase 1 Trunked radio traffic
3. P25 Phase 2 Trunked radio traffic, as an OPTIONAL future upgrade
4. All analog channels radio traffic
5. Call taker administrative calls
6. Administrative SIP IP Trunks

E. The logging recorder shall interface directly with the System for audio and P25 data.

1. Recorders that only interface through the dispatch consoles or the console subsystem are not acceptable for System recording.
2. P25 recording may require a stand-alone encrypt/decrypt device.

F. The System shall be able to record and playback AES encrypted radio system talkgroups.

G. Other PSAPs and/or dispatch center(s) participating in the System shall have remote access to the logging recorder.

H. The System shall be designed to continuously operate 24-hours per day, 365 days per year providing recording, storage, assembly, retrieval/playback, and reporting of voice traffic.

I. The System shall be scalable and provide the capability to accommodate 25% future growth (over a 10-year period) of the radio communications system with only the addition of hardware and or software.

J. The logging recorder shall be capable of being mounted in a TIA standard 19" wide rack.

K. The logging recorder subsystem shall accept an external IP-NTP timing reference.

L. The logging recorder subsystem shall share the common timing reference with the radio system and console system.

M. The System shall be based on a client/server architecture that allows for the secure transfer of digital audio, playback, and secure access.

N. The System's administrative and maintenance capabilities shall be accessible by any Windows-based personal computer (PC) connected and authenticated on the IP network interfaced with the proposed system.

O. The logging recorder shall be capable of individual user logon. Each assigned logon shall have a specific level of access to channels and authorized permissions.

P. Logging recorder critical hardware shall be equipped with dual power supplies.

Q. The System shall report the following failures or issues as a minimum:

1. Hardware failure or malfunction
2. Software failure or malfunction
3. Failure to record audio from any of the traffic specified

R. The System shall support four methods of alarm reporting as a minimum, including, but not limited to:

1. LED (Local)
2. Audible alarm (Local)
3. Monitoring application

S. The System shall notify the dispatcher and supervisor if audio is not successfully being recorded when the record function has been selected.

1.4.2 Storage/Capacity Requirements

A. The System shall support the most recent version of Microsoft® SQL Server, the City's standard database.

B. Each recording module shall be able to store a minimum of 80,000 channel-hours per hard drive and shall store two calendar years of data.

C. The System shall automatically archive files unless archiving is disabled (per City request/approval).

D. The System database shall be a non-proprietary database to ensure ease of maintenance.

E. The System shall be equipped with Redundant Array of Independent Discs (RAID) Level 1 or level 5.

1.4.3 Archive Storage Requirements

A. The System shall be able to archive recordings to a centralized storage unit.

B. Contractor shall state the types of external data archiving devices their system can support.

C. The System shall be able to support single and dual archive devices in the event the City adds additional archive devices.

D. The System shall support manual archiving.

E. The System shall support archiving where both recorders archive simultaneously should the fault-tolerant solution require redundant recorders.

1.4.4 Transferable Storage Requirements

A. The System shall have, as a minimum, the ability to transfer files by the following methods:

1. USB connected flash/thumb drive
2. Internally connected CD/DVD drive

B. The System shall support the ability to retrieve recordings and write them to portable storage media in standard digital media formats (e.g., .wav, .wmv, .mov, .avi, mp4) for playback.

1.4.5 Retrieval Requirements

A. The System shall include a customizable graphical user interface (GUI), allowing dispatchers and supervisors with the ability to search, locate, and retrieve single and multimedia recordings.

B. The System shall allow users to “pin” or “tag” recordings that they retrieve for later review.

C. The System shall allow users to retrieve, export, and distribute via email audio and multimedia recordings.

1.4.6 Search Requirements

A. The System shall support the following search and playback parameters for all dispatch console system and CAD positions for any combination of available data elements from the City mission-critical communications systems:

1. Time and date
2. Duration
3. Channel ID(s)

4. Console position(s)
5. Extension number(s)
6. Individual call(s)
7. Subscriber unit ID(s)
8. Talkgroup ID(s)
9. Dialed number(s)
10. Calling number(s)
11. ANI/ALI data
12. Incoming or outgoing calls
13. Agency or agencies
14. CAD incident ID(s)
15. CAD status and type(s)

1.4.7 Playback Requirements

A. The System shall provide the ability to combine any number of search criteria into a single search.

B. The System shall be able to search and play all channels/talkgroups simultaneously.

C. The System shall allow users to set markers within a recording and the search and replay function shall be capable of displaying the markers when playing back.

D. Automatic gain control (AGC) shall be available for all replayed audio. The System administrator shall have the ability to enable or disable AGC.

E. The System shall support the ability to display and save all recordings associated with an incident to a single directory or location.

F. The System shall support the ability to playback recordings in mixed mode, where the recordings are replayed as they occurred or in sequential mode.

G. The System shall provide the ability to vary the playback speed of each recording without pitch distortion.

H. Fifteen concurrent licenses shall be provided for playback operation.

1.4.8 Instant Recall Requirements

A. The System shall support Instant Recall. Instant Recall shall provide users the ability to instantly replay a message from any PC connected and authenticated on the IP network interfaced with the System.

B. Instant Recall shall allow users to skip forward, skip backward, pause, stop, and play recordings.

C. Similar to normal playback mode, Instant Recall shall allow users to control the speed of the replay without pitch distortion.

D. Instant Recall shall allow users to access all calls recorded within the previous 24 hours.

E. Instant Recall shall be configurable to allow access to a group of channels/talkgroups from each dispatch console position.

1.4.9 Incident Assembly and Reporting Requirements

A. The System shall allow telecommunicators and supervisors to assemble single or multimedia recordings into an event and generate reports for analysis.

B. The System shall allow users to locate, assemble, play, and export any recorded data in a single audio (.wav) or standard multimedia file (e.g., .wmv, .mov, .avi, mp4) for playback.

C. The System shall be able to play assembled single and multimedia events using an internal or external player.

D. The System shall allow users to easily switch between recorded source data, CAD records, and the assembled event file(s).

E. The System shall allow users to assemble multiple events from different source recordings simultaneously.

F. The System shall log the source recordings, the sequence in which users assemble them, and all metadata associated with the records for audit purposes.

G. The System shall allow users to generate custom reports. Contractor shall detail the types of reports that users can create.

1.5 Network Management System (NMS)

1.5.1 General Requirements

A. The radio system shall include a new network management system (NMS) that monitors all system components, and provides Fault, Configuration, Accounting, Performance, and Security management (FCAPS) functions.

B. The NMS shall provide alarm reporting and to remotely diagnose system outages and perform preventative maintenance activities.

C. Contractor shall work with the City to ensure proper equipment configuration to enable monitoring by the NMS. All subsystem NMS shall be able to send all traps, alarms, and notifications to the supplied integrated NMS, and City designated staff or support vendor.

D. The NMS shall monitor real time and ensure proper equipment configuration, operation, and integration of existing systems.

E. Systems that the NMS shall support include, but are not limited to:

1. P25 radio system
2. Dispatch console system
3. Logging recorder system
4. Backhaul network system
5. Site infrastructure alarms
6. Contractor-supplied subsystem(s) as required
7. Environmental temperature & humidity status

F. The NMS shall display system status and alarm conditions and shall provide the ability for secure (VPN with two-factor authentication security), remote access to the System to check the operational status and view alarms through the network. This includes the ability to:

1. Monitor the health of all networked devices
2. Remotely interrogate equipment and troubleshoot to board level failures
3. Configure components remotely
4. Routinely backup remote equipment configuration
5. Remotely restore equipment configuration
6. Push updates to remote equipment
7. Generate system statistical reports
8. Provide paging function based on multiple levels of fault configurations

G. Network management of the System includes:

1. Maintaining network components
2. Upgrading network components when necessary
3. Managing encryption capabilities

4. Managing and operating over-the-air features
5. Optimizing performance
6. Managing intersystem interoperability

H. The NMS shall provide management of user equipment and system configuration regarding user management. Areas of management include, but are not limited to:

1. Talkgroup population
2. User access privileges
3. Security assignments
4. Failure reports
5. Usage reports
6. Performance reports
7. Other Contractor-recommended reports

I. The NMS shall include storage to support no less than 18-months retention of all system data and reporting, without the need for removable or external archiving equipment.

J. Key functional elements of the NMS are:

1. Local administration database
2. Real-time airtime usage
3. Real-time monitoring of network element status
4. Hierarchical updates on error condition
5. Real-time status of network usage
6. Real-time alarm management (provides easy and intuitive maintenance)
7. Simple Network Management Protocol (SNMP) support allowing interfaces with higher-level network management systems
8. Simple Mail Transfer Protocol (SMTP) and Short Message Service (SMS) support to allow for email and text notification of system issues and alarms

1.5.2 Management Access

A. The System shall support creation of profiles that, for each set of user credentials, allows view or read/write access to only selected parts of entire system management capabilities.

B. The System shall include 10 concurrent licenses for management access: some departments may only require capability of "read-only" access.

1.5.3 Management Equipment

A. Contractor shall include two full sets of Network Management Terminal (NMT) equipment with one set to be located at the City specified location and the other to be located at a location to be defined later by the City (and with connectivity to the radio network to be provided by the City). An NMT shall include:

1. Computer
2. Display
3. Keyboard, mouse, interfaces
4. Networking

B. Contractor shall also include networking equipment to allow secure (two-factor security) remote access to all system management features from an existing City computer that has internet access.

1.5.4 Site Conditions/Points to be Monitored

A. Each proposed site shall include a remote terminal unit (RTU) for monitoring and reporting of physical site alarms.

B. Contractor shall include all hardware, software, other necessary interconnection equipment, and services to monitor, at a minimum, 20 conditions/points at sites and shall generate, via the management system, alarms upon configurable events. Examples of such conditions/points are the following:

1. Door Open
2. Door Bypass
3. Temperature High
4. Temperature Low
5. AC Fail
6. Services (alarms)
7. DC Powered
8. UPS AC Fail
9. UPS Low Battery
10. UPS Alarm

11. UPS Bypass
12. Generator Run
13. Generator Trouble
14. Tower Lights
15. Smoke
16. RF Power Output
17. Antenna system VSWR

1.6 OPTIONAL Unit Location Services

A. Contractor shall provide OPTIONAL Unit Location Services for all subscriber units listed in Appendix C that may use this feature on the System.

B. Contractor shall supply any gateway and server equipment required to enable unit location services based upon GPS location transferred over the System using the P25 Tier 2 GPS standard.

C. Contractor shall state the full feature set provided by the proposed/provided interface.

D. Given the current channel counts, the Contractor shall state how many active units the System can support reporting location once every 5 minutes on a site-by-site basis.

E. The System shall be fully compatible with applicable P25 GPS/Location standards.

F. This interface shall provide access to all location data generated by the user units equipped and activated with GPS receivers.

G. This interface shall allow the execution of commands related to the collection of location information:

1. Requesting a location update
2. Establishing location poll rates
3. Adjusting location poll rates
4. Selecting units for "fast-polling"
5. Disabling location polling and updates

1.7 OPTIONAL Smartphone/Broadband Device Integration

A. As an OPTION, Contractor shall supply a smartphone/broadband device integration solution (SPBBI system) that integrates voice and data communications between City P25 radio system users and City users with broadband devices and/or smartphone applications.

B. The SPBBI system shall provide Push-to-Talk (PTT) communications operating over private and public Wi-Fi networks, 4G/5G carrier networks, and FirstNet's 4G/5G LTE network.

C. The SPBBI system shall support both carrier integrated PTT over cellular (PTToC) operations and over the top PTToC operation on carrier networks as well as private and public Wi-Fi networks.

D. The SPBBI system shall support management of the following features and functions:

1. Quality of Service
2. PTT Call Priority
3. Preemption

E. The SPBBI system server hardware shall be implemented using high-reliability internally redundant processor platforms.

F. The SPBBI system shall operate in a virtualized environment, providing the hardware providing that environment meets this requirement.

G. The SPBBI system shall support reporting and display of location information for broadband and smartphone user devices.

H. The SPBBI system shall provide an interface to an audio recording and retention (logging recorder) system, meeting the legal and operational requirements of the City.

I. The SPBBI system shall employ compliant open standards for encryption and authentication, subject to applicable City policy.

J. The SPBBI system shall include the necessary hardware, software, and licensing to provide TIA-102.BACA (P25 ISSI) network-level communications and the following P25 supplemental services:

1. Group calls
2. Individual calls
3. Emergency calls
4. Call alert

5. Radio check
6. Radio detach
7. Radio inhibit/uninhibit
8. Radio unit monitor
9. Short message
10. Status query

K. The SPBBI system shall provide end-to-end, 256-bit AES encryption from P25 system users to smartphone and broadband devices as well as to P25 system dispatchers without transcoding.

L. The SPBBI system shall have the following capacity and scaling features and functions:

1. Minimum of 50 simultaneous P25 group calls
2. Minimum of 50 concurrent end-to-end P25 talkgroups
3. Minimum of 100 talkgroups

M. The SPBBI system shall support Android™ and iOS™ mobile platforms.

N. The SPBBI system shall support Android™, Windows 10, and iOS™ tablet and/or desktop platforms.

O. The SPBBI system shall support managed group and PTT communications utilizing commercially available smartphones

P. Contractor shall provide Smartphone access to all subscriber units listed in Appendix C that may use this feature on the System.

2. Field/Subscriber Radio Equipment

This section describes the general, functional, and operational requirements of the desired subscriber radio equipment (or devices).

2.1 General Requirements

A. The new radio systems shall include new VHF and UHF subscriber equipment, with radio counts identified in the City provided inventory (see *Appendix C Subscriber Unit Information.xlsx*). Contractor shall price High-Tier for the Police Department, Mid-Tier for remaining departments, and Low-Tier as an OPTION.

B. Contractor shall provide new subscriber units for the departments and quantities specified. Appendix C provides a list of existing subscriber unit inventory with departments and quantities.

C. Where possible, Contractor shall re-use existing City P25 capable radios. Contractor shall provide program these units to operate on the new System.

D. All VHF subscriber units shall be equipped and configured to operate on a VHF analog system, upgradeable to P25 Phase 1 Conventional.

E. All UHF subscriber units shall be capable of, but not limited to the following set of requirements:

1. Subscriber units shall be equipped and licensed for transmitting and receiving P25 conventional mode calls
2. Subscriber devices shall be equipped and licensed for transmitting and receiving P25 Phase 1 trunking mode calls
3. Subscriber devices shall be capable of transmitting and receiving P25 Phase 2 trunking mode calls
4. Subscriber units shall be capable of transmitting and receiving analog conventional mode calls
5. Subscriber unit software shall be flash programmable for adding future software enhancements
6. Subscriber units shall be programmable and rekeyed through a standard workstation computer
7. OPTIONAL – subscriber units shall be capable and licensed for OTAR
8. OPTIONAL – subscriber units shall be capable and licensed for OTAP
9. OPTIONAL - subscriber units shall provide Wi-Fi capability
10. OPTIONAL - subscriber units shall provide LTE capability (4G/5G carrier networks and/or FirstNet's™ 4G/5G LTE network)

F. At the time of proposals, subscriber units shall have been developed and successfully tested through the P25 CAP process.

G. Subscriber units shall support either the IMBE (Baseline) Project 25 vocoder or the Project 25 Enhanced Full Rate Vocoder (AMBE + 2); however, the latter is preferred.

H. Subscriber units shall support the configuration of the power output and shall be configured to operate at as low as one-half of maximum specified power without violating FCC Type Acceptance.

I. Subscriber units shall support the following channel scan requirements:

1. Sequentially scan conventional channels (at least 8) in clear mode.
2. While on the System's control channel, the subscriber units shall sequentially scan talkgroups (at least 8) in both clear and encrypted mode.
3. The conventional talkgroups to be scanned shall have selectable priority.
4. Scan selection shall be retained during power-off/on (power-on default shall be the last operator selection).
5. Subscriber units radios shall also support the ability for users to configure or alter scan operations including the definition of a scan list.

J. Subscriber units shall support the requirement that they be programmed by only those individuals who are in the possession of a hardware-based advanced or enhanced system key.

K. Subscriber units shall support a programming file management feature that allows the subscriber radio programming files to be created and stored in a centralized database, including a description of the programming file and designators of the subscriber radios for which it is to be applied (programmed).

L. This feature shall allow a remote user to access programming files created by the programming software and stored on the database (and that are specifically designated for their radios by the radio alias) and to program them into those specifically identified radios.

M. Contractor shall include all software and hardware necessary to support the creation of programming files to be stored on the centralized database as well as for the centralized database itself.

N. The programming of encryption and authentication keys into subscriber radios shall be accomplished via a key management tool ("key fill device") that complies with TIA-102.AACD.

O. The key management tool shall be used to view, change, erase, and activate keys individually or in groups.

P. The key management tools shall be configured to be either "controlling" or "compliant" such that a controlling key management tool can dictate the encryption keys that the compliant key management tool can use, and the compliant key management tool can use only those keys that it receives from the controlling key management tool.

Q. Both the controlling and compliant key management tools shall be capable of programming into subscriber radios, the keys that they contain.

2.2 Portable Radios - General Requirements

A. Portable radios shall be rugged, waterproof, and equipped with display, noise cancelling technology, and emergency button configured.

B. Portable subscriber radios shall include a flexible, covered antenna (readily removable utilizing a screw-in connector). BNC connectors are not acceptable.

C. Batteries shall connect securely to portable subscriber radios and shall not require the use of tools to attach or remove.

D. Contractor shall provide portable radios with noise cancelling technology.

E. Internal speaker/ microphone shall include:

1. Connection of an external speaker/microphone that mutes the internal speaker/ microphone
2. Connection of an external earpiece that mutes the internal speaker

F. Universal or individual connectors with the following features:

1. Microphone and earpiece connections shall be capable of supporting the following types of microphone/earpiece devices (including types used in surveillance):
    a. External speaker/ microphone
    b. Earpiece
    c. Programming interface

G. The attachment point on the portable radio shall be on the portable radio's main chassis and not on the radio's battery. The attachment point shall be at a point on the radio that can be worn at hip level in a belt clip.

H. As an OPTION, portable subscriber units shall be capable of GPS based unit location services.

2.2.1 Portable Radio - High-Tier Model

A. The High-Tier portable radios shall provide multi-band capabilities to operate in the following frequency bands:

1. 700/800 MHz: 769 – 870 MHz
2. UHF: 380 – 520 MHz
3. VHF: 136 – 174 MHz

B. The High-Tier portable radios shall provide the following capabilities for user controls and displays:

1. Push-to-talk switch
2. On-Off/Volume knob, mounted on top
3. Two soft keys
4. Minimum of 3 navigation keys
5. Alphanumeric keypad (4 x 3)
6. Emergency button, mounted on top with easy access
7. Top-mounted rotary switches allow use of three "banks" of channels/talkgroups, each bank consisting of 16 channels/talkgroups
8. Front display with two lines of text (minimum 12 characters per line) and status icons for battery status and in-range indicator
9. Display shall be readable in all conditions from direct sunlight to total darkness
10. Indicators shall be capable of being disabled in surveillance mode:
    a. Transmit
    b. Receive
    c. Battery Status
    d. Encryption Status

C. Contractor shall offer OPTIONAL VHF High-Tier portable radios in a "Fire Service" configuration that includes:

1. Intrinsic Safety certification
2. Extended environmental specifications (beyond those listed in Section 2.2.5)
3. Larger and easier to access knobs and controls
4. Highly visible color(s)

2.2.2 Portable Radio - Mid-Tier Model

A. The Mid-Tier portable radios shall provide dual-band capabilities to operate in the following frequency bands:

1. UHF: 380 – 520 MHz
2. VHF: 136 – 174 MHz

B. The Mid-Tier portable radios shall provide the following capabilities for user controls and displays:

1. Push-to-talk switch
2. On-Off/Volume knob, mounted on top
3. Two soft keys
4. Minimum of 3 navigation keys
5. Emergency button, mounted on top with easy access
6. Top-mounted rotary switches allow use of three "banks" of channels/talkgroups, each bank consisting of 16 channels/talkgroups
7. Front Display with two lines of text (minimum 12 characters per line) and status icons for battery status and in-range indicator
8. Display shall be readable in all conditions from direct sunlight to total darkness
9. Indicators shall be capable of being disabled in surveillance mode:
    a. Transmit
    b. Receive
    c. Battery Status
    d. Encryption Status

2.2.3 Portable Radio - Low-Tier Model

A. The Low-Tier portable radios shall provide single-band capabilities to operate in one of the following frequency bands:

1. UHF: 380 – 520 MHz
2. VHF: 136 – 174 MHz (for Fire Department)

B. The Low-Tier portable radios shall provide the following capabilities for user controls and displays:

1. Push-to-talk switch

2. On-Off/Volume knob, mounted on top
3. Emergency button, mounted on top with easy access
4. Top-mounted rotary switches allow use of three "banks" of channels/talkgroups, each bank consisting of 16 channels/talkgroups
5. Display with one line of text (minimum 12 characters per line) and status icons for battery status and in-range indicator
6. Display shall be readable in all conditions from direct sunlight to total darkness

2.2.4 Portable Radio Programming Capacities

A. The High-Tier portable radios shall have a channel capacity of 1,200 channels.

B. The Mid-Tier portable radios shall have a channel capacity of 1,000 channels.

C. The Low-Tier portable radios shall have a channel capacity of 512 channels.

2.2.5 Portable Radio - Environmental Requirements (all tiers)

A. All portable radios shall meet or exceed the following environmental specifications per MIL-STD-810E (or equivalent items in 810 F):

1. Operating Temperature: -30 C to +60 C
2. Low Pressure Operation: 500.3 Procedure II
3. High Temperature, Storage / Operation: 501.3 Procedure I / II
4. Low Temperature, Storage / Operation: 502.3 Procedure I / II
5. Temperature Shock: 503.3 Procedure I
6. Solar Radiation: 505.3 Procedure I
7. Humidity: 507.3 Procedure II
8. Dust, Blowing: 510.3 Procedure I
9. Vibration: 514.4 Procedure I
10. Shock, Functional: 516.4 Procedure I
11. Rain, Blowing / Dripping Water (for metal case): 506.3 Procedure I / II
12. Salt Fog (for metal case): 509.3 Procedure I

B. The "Fire Service" configuration of the High-Tier portable radio shall include environmental specifications beyond those listed here.

2.2.6 Portable Radio Batteries

A. All portable radios shall be equipped with standard-capacity batteries that, when starting with a full charge, allow operations for 12 hours at a duty cycle of 5% transmit, 5% receive, and 90% idle.

B. Contractor shall offer OPTIONAL high-capacity batteries that, when starting with a full charge, allow operations for 16 hours at a duty cycle of 5% transmit, 5% receive, and 90% idle.

C. All portable radios shall be equipped with batteries that have a typical time to charge or recondition from fully drained to fully charged of 8 hours or less.

D. Both single and multiple-unit (six portable radios, minimum) chargers shall be available for the portable subscriber units, and both shall operate from 110 VAC sources.

1. Both shall support a rapid charge of batteries (complete charge in 1 to 2 hours), and
2. Both shall support the standard-capacity and/or high-capacity batteries (connected to their radios or not).

2.2.7 Portable Radio - Basic Accessory Package

A. A basic portable radio accessory package shall be proposed for all tiers listed above and it shall include the following:

1. Radio
2. Standard Battery (meeting the above-listed requirements)
3. Radio antenna (with options of quarter-wave or half-wave flexible dipole)
4. Single-unit 100-240VAC charger

B. Contractor shall provide catalog of accessories available for the different tiers of radios, including but not limited to remote speaker mics, Bluetooth headphones with noise cancellation, tactical audio accessories (suitable for SWAT team), single and multi-bay chargers, vehicle chargers, belt clips, and swivel cases.

2.2.8 Portable Radio - Shoulder Mic Accessory Packages

A. A speaker-mic portable radio accessory package shall be offered as an OPTION for all tiers, and it shall include the following:

1. Radio
2. Standard Battery (capable of meeting the above-listed requirements)

3. Remote speaker-microphone (heavy-duty, palm-type with push-to-talk switch, emergency button and self-retracting coil cord)
4. Radio antenna (with quarter-wave or half-wave flexible dipole)
5. Single-unit 100-240VAC charger

B. Contractor shall offer a Bluetooth OPTION for all subscriber tiers and accessories.

2.3 Mobile Radios - General Requirements

A. The Mobile radios shall be constructed with the following distinct components:

1. A chassis configured for mounting in the dash of City vehicles as specified in Appendix C
2. A chassis configured for mounting in the trunk or other similar compartment of City vehicles as specified in Appendix C
3. A control head configured for remote mounting (e.g., trunk) or in the console or dash in the front of a vehicle with a cable length of 17 feet minimum and a round-type cable with single protective outer sheath enclosing all other conductors
4. A microphone with a self-retracting coil cord that shall be 4 feet long (minimum) when extended
5. An internal speaker of at least 5W or an external speaker
6. Installation brackets and interface cables for all above components

B. As an OPTION, mobile radios shall be capable of GPS based unit location services.

2.3.1 Mobile Radio - High-Tier Model

A. The High-Tier mobile radios shall provide multi-band capabilities to operate in the following frequency bands:

1. 700/800 MHz: 769 – 870 MHz
2. UHF: 380 – 520 MHz
3. VHF: 136 – 174 MHz

B. The High-Tier mobile radios shall provide the following capabilities for user controls and displays:

1. Push-to-talk switch on microphone
2. On-Off button

3. Volume knob
4. Rotary knob for mode or zone selection, each bank consisting of 16 channels/talkgroups
5. Five soft keys
6. Full-size DTMF keypad
7. Siren control buttons
8. Emergency button

C. Display with two lines of text (minimum 12 characters per line) plus one line of icons and one line of menus.

D. Display shall be readable in all conditions from direct sunlight to total darkness.

E. Contractor shall offer OPTIONAL VHF High-Tier mobile radios in a "Fire Service" configuration that is the same as above but shall contain:

1. A ruggedized and water-resistant control head
2. A water-resistant palm microphone (instead of a standard palm microphone)
3. An internal speaker (internal to the control head)
4. The ability to interface to a City-provided headset via a 6-wire connection

2.3.2 Mobile Radio - Mid-Tier Model

A. The Mid-Tier mobile radios shall provide dual-band capabilities to operate in the following frequency bands:

1. UHF: 380 – 520 MHz
2. VHF: 136 – 174 MHz (for Fire Department)

B. The Mid-Tier mobile radios shall provide the following capabilities for user controls and displays:

1. Push-to-talk switch on microphone
2. On-Off button
3. Volume knob
4. Rotary knob for mode or zone selection, each bank consisting of 16 channels/talkgroups
5. Five soft keys
6. Emergency button

C. Display with two lines of text (minimum 12 characters per line) plus one line of icons and one line of menus

D. Display shall be readable in all conditions from direct sunlight to total darkness

E. The Mid-Tier mobile radios shall also be proposed in a "Motorcycle" configuration that is the same as above, but shall contain:

1. A water-resistant palm microphone (instead of a standard palm microphone)
2. A water-resistant speaker (instead of a standard speaker)
3. Motorcycle power and radio interface cables

2.3.3 Mobile Radio - Low Tier-Model

A. The Low-Tier mobile radios shall provide single-band capabilities to operate in one of the following frequency bands:

1. UHF: 380 – 520 MHz
2. VHF: 136 – 174 MHz (for Fire Department)

B. The Low-Tier mobile radios shall provide the following capabilities for user controls and displays:

1. Push-to-talk switch on microphone
2. On-Off button
3. Volume knob
4. Rotary knob for mode or zone selection, each bank consisting of 16 channels/talkgroups
5. Three soft keys
6. Emergency button
7. Display with one line of text (minimum eight characters per line) plus one line of icons and one line of menus
8. Display shall be readable in all conditions from direct sunlight to total darkness

2.3.4 Mobile Radio Programming Capabilities

A. The High-Tier mobile radios and control stations shall have a channel capacity of 1,200 channels.

B. The Mid-Tier mobile radios and control stations shall have a channel capacity of 1,000 channels.

C. The Low-Tier mobile radios and control stations shall have a channel capacity of 512 channels.

2.3.5 Mobile Radio - Environmental Requirements (all tiers)

A. All mobile radios shall meet or exceed the following environmental specifications per MIL-STD-810E (or equivalent items in 810 F):

1. Operating Temperature: -30 c to +60 C
2. Low Pressure Operation: 500.3 Procedure II
3. High Temperature, Storage / Operation: 501.3 Procedure I / II
4. Low Temperature, Storage / Operation: 502.3 Procedure I / II
5. Temperature Shock: 503.3 Procedure I
6. Solar Radiation: 505.3 Procedure I
7. Humidity: 507.3 Procedure II
8. Dust, Blowing: 510.3 Procedure I
9. Vibration: 514.4 Procedure I
10. Shock, Functional: 516.4 Procedure I
11. Rain, Blowing / Dripping Water (for metal case): 506.3 Procedure I / II
12. Salt Fog (for metal case): 509.3 Procedure I

2.4 Desktop Radio / Control Station Requirements

A. Contractor shall provide multiband desktop radios / control stations capable of operating in the following frequency bands:

1. 700/800 MHz: 769 – 870 MHz
2. VHF: 136 – 174 MHz
3. UHF: 380 – 520 MHz

B. Desktop radios / control stations shall be supplied complete with desktop microphone, mounting hardware, coaxial cable and unity gain antennas to provide for a complete installation.

C. Desktop radios / control stations and antenna systems shall be installed following the Contractor's selected site grounding specifications.

D. Desktop radios / control stations shall be able to be remotely controlled via multiple desk set devices. Contractor shall detail how many desk set devices can control a single control station.

E. Full function desk sets shall be able to control every feature available on the front panel of the control station.

F. Desktop radios / control stations shall support the following features:

1. Full compliance with P25 features and operation
2. Desk top microphones
3. Front-mounted on/off volume knob
4. Talkgroup/channel selector
5. Emergency button, protected from inadvertent activation
6. Alphanumeric display
7. Transmit indicator
8. AES encryption

G. Contractor shall provide, at a minimum, the following control station accessories:

1. Cables:
    a. Data cables
    b. Extension cables
    c. Adapters
    d. Power cables
2. Antennas
3. External Speakers
4. Public address kits
5. Desktop microphone

H. Desktop radios / control stations shall comply with the programming capacities specified for the High-Tier mobile radios.

I. Desktop radios / control stations shall comply with the environmental requirements specified for the mobile radios.

2.5 Subscriber Radios - Programming Equipment

A. Contractor shall provide the following sets of programming equipment as required for programming the new subscriber radios.

1. Subscriber Personality Development and Programming Security License and Dongle – quantity of 6
2. Key Fill Device Cables Set – quantity of 6
    a. Each Set Contains All Cables Required for Key Fill Operation for All Proposed Portable, Mobile, Control Station, Vehicular Repeater and Smartphone, Tablet, and Computer SUs
3. Key Loaders – quantity of 2

B. Computers on which programming software is to operate shall not be included with the System but the Contractor shall state specifications for the computers to be procured separately by the City, on which such software is to operate at the time of detailed design.

3. Backhaul Network Requirements

This section describes the general and functional requirements of the desired backhaul network. While not a design, this section specifies requirements for system architecture and performance including redundancy, capacity, and path availability.

3.1 General Backhaul Requirements

A. Contractor shall integrate all proposed sites into the System backhaul network, including but not limited to:

   1. Existing City-owned or -occupied RF sites, as applicable
   2. Existing County-owned or -occupied RF sites, as applicable
   3. New proposed System control and/or RF site(s)
   4. Backhaul only sites (existing and/or proposed)
   5. Dispatch facilities

B. Contractor shall evaluate and leverage existing dark fiber availability (Single Mode). See Appendix B for additional details.

C. Contractor shall evaluate and leverage existing microwave equipment to the extent possible.

D. If existing or available backhaul network cannot support the proposed radio system, Contractor shall provide new backhaul connectivity via optical fiber and/or new microwave equipment (including antenna systems).

E. New backhaul equipment shall be implemented for new RF sites not part of the existing radio system.

F. Contractor shall provide their System design backhaul requirements for Contractor-provided microwave hops, including but not limited to:

   1. Bandwidth
   2. Packet loss
   3. Latency
   4. Jitter

G. Contractor shall provide backhaul network diagrams showing required connectivity (physical and logical) between all proposed sites.

H. Contractor shall specify Layer 2 and Layer 3 networking requirements and provide an IP addressing scheme/plan on a per-device/per-site basis.

I. Contractor shall specify the recommended connectivity type (i.e., fiber, ring, spur) for each site in the proposed System design.

J. Contractor shall specify where redundant backhaul connections are recommended for maximum availability in the proposed System design.

K. Contractor shall develop and maintain a spreadsheet that identifies the backhaul requirements on a per-hop (or per-site) basis.

L. Contractor shall specify test(s) (such as RFC 2544) to be completed to validate that the backhaul network meets the Contractor's System requirements.

M. Prior to site installations, Contractor shall provide a schedule (on a per-site basis) for site installations and optimization so that the City can verify that the backhaul is ready prior to Contractor functional testing.

3.2 General Microwave Requirements

A. The new microwave backhaul system requirements are:

1. Contractor shall provide new digital Ethernet/IP microwave links where existing fiber, microwave, and/or RF links are not available to connect System sites (existing and new).

2. The City prefers a fault tolerant backhaul design. If not possible, the use of microwave spurs shall be pre-approved by the City. If spurs are allowed, there shall be a maximum of one site per spur. There shall not be multiple sites on a spur, where a failure at one site would result in loss of communications to multiple sites. All spurs shall be monitored hot standby (MHSB).

3. Contractor shall utilize the appropriate frequency band for each microwave link to meet the specified performance requirements. All microwave links shall utilize licensed frequencies; unlicensed microwave is unacceptable.

B. Existing City fiber, where available, can be utilized to replace microwave links and/or to establish path redundancy.

C. Contractor shall be responsible for all microwave frequency research, prior coordination and preparation of all associated FCC license applications and submittals on behalf of the City.

D. The microwave backhaul system shall be configured using a mesh architecture or multiple interconnected rings to maximize route diversity and minimize single-points-of-failure. Rings shall have a minimum of two connection points to adjacent rings, to provide route redundancy for inter-ring traffic.

E. Contractor shall be solely responsible for the new microwave backhaul system performing as specified in this RFP and to be compliant with all new or modified FCC radio station licenses.

F. Microwave backhaul links shall be equipped with new radios, antennas, waveguide, dehydrator, and accessories.

G. The microwave backhaul system shall:

1. Utilize Ethernet/IP technology. Ethernet/IP-based connections shall be transported end-to-end in its native format with no intermediate time division multiplex (TDM) conversion.
2. Support a smooth transition from the existing systems to future Ethernet/IP-based radio systems.
3. Utilize Multi-Protocol Label Switching (MPLS) to support different interfaces. Contractor shall provide MPLS routers needed to support their proposed System design.

H. All microwave links within a ring shall be configured for loop protection.

I. All components shall have been fully tested in the field, having a proven service history of over 3 years in public safety radio systems.

J. Manufacturers that supply components for the System shall have a proven and known supply chain to serve the City for the lifecycle of the network.

K. Software and firmware updates shall be thoroughly regression tested prior to release and implementation. Software updates shall include release information identifying the changes made, either to repair a problem or enhancements made.

3.3 System Performance Requirements

A. Microwave links shall be designed for a minimum two-way end-to-end annual availability of 99.999% at a bit error rate (BER) of 10-6, at a minimum capacity of 50 Mbps and maximum capacity of 150 Mbps.

B. All microwave channels shall be licensed for a minimum of 30 MHz bandwidth.

C. Microwave radios shall deliver two-frequency, full duplex operation. Space diversity configurations are acceptable, if necessary, to meet path availability requirements.

D. Contractor shall specify frame loss, packet latency, and jitter performance of the microwave backhaul network and ensure that such performance will meet the requirements for the proposed System.

E. The network shall support the following QoS techniques:

1. Classification (Layer 1/Layer 2/Layer 2.5/Layer 3)
2. Marking (Layer 2/ Layer 2.5/ Layer 3)

F. The network shall honor incoming QoS settings throughout the packet transport network and ensure that the IP packet markings remain set when each packet reaches its destination and is delivered to the local network.

G. QoS techniques shall be capable of dropping packets of a lower priority when required to maintain the throughput of the higher priority packets or designating traffic of different priorities to different or alternate paths through the network. The network shall ensure that the high priority traffic is transported should the throughput on a path drops below predetermined network thresholds due to a microwave path degradation or other interference.

3.4 Microwave Backhaul Equipment

3.4.1 Microwave Radios

A. The City prefers the use of all-indoor radios only. The City will consider split-mount or all-outdoor microwave radios as an OPTION only if they meet the performance requirements specified herein.

B. All microwave radios shall:

1. Be new equipment.
2. Be 19” rack mountable as applicable for split-mount or indoor units.
3. Be type accepted for licensing under Part 101 of the FCC Rules and Regulations.
4. Support the transport of TDM signals via pseudowire without external equipment.
5. Support built-in error detection and correction.
6. Be capable of encrypting network traffic, using Advanced Encryption Standard (AES), using a 256-bit cryptographic key; however, in the initial system deployment the new network shall not be configured to encrypt traffic. Encryption, if any, will be done by end-user devices.
7. Be equipped for Adaptive Coding and Modulation (ACM) with a range of modulations from QPSK to 256QAM or higher, to allow the radios to automatically adjust the modulation during path fading to prevent total loss of communications. Switching between modulation rates shall be error-free for all traffic.

8. Support monitored hot standby (MHSB), space diversity (SD), combined HSB/SD, and frequency diversity (FD). Average transmitter switching times for MHSB and SD shall be not more than 50 ms, and receiver path switching shall be errorless.
9. Be equipped for -48 VDC operation and have redundant power supply cards.
10. Have a minimum mean time between failure (MTBF) of 20 years.
11. Provide sufficient transmit output power to meet the requirements of each link and comply with frequency coordination limitations and applicable FCC rules.
12. Be equipped with hitless and errorless Automatic Transmit Power Control (ATPC).
13. In MHSB mode, configurable so that a fault detected in the online transmitter shall cause that transmitter to mute and the standby transmitter to unmute.
14. Be capable of ensuring that the receiver with the better performance is operational at any given moment.
15. Automatically transfer from the main receiver to the standby receiver and back without introducing traffic errors (hitless/errorless switching).
16. Be Network Equipment Building System (NEBS) Level 3 compliant.
17. Be Federal Information Processing Standard (FIPS) 140-2 Level 2 compliant.
18. Comply with the thermal shock test requirements established in Telcordia Technical Advisory TA-TSY-000752
19. Utilize shielding and filtering to prevent Radio Frequency Interference (RFI) to/from other radio frequency (RF) equipment installed near the proposed equipment

3.4.2 Split-Mount Radios

A. All split-mount radios shall:

1. Be new equipment.
2. Include an indoor unit (IDU) and one or more outdoor radio frequency outdoor units (ODU)
3. Support operation on the licensed 6, 11, 18 and 23 GHz bands
4. Support channel bandwidths up to 60 MHz

B. The connecting cable between the IDU and ODU shall be hardened for outdoor installations in a coastal environment and shall be tied into the grounding.

C. IDU's shall operate to specification from 14ºF to 122ºF, and 0% to 95% humidity (non-condensing).

D. ODU's shall operate to specification from -25 ºF to 155 ºF, and 100% humidity.

E. The ODU shall Incorporate an RSSI port for antenna alignment purposes.

F. All split mount radios shall have an indirect ODU mount option to allow the ODU to be mounted on the tower, either close to the antenna and connected to the antenna with flexible waveguide, or at the base of the tower and connected to the antenna with waveguide.

3.4.3 All-Indoor Radios

A. All-Indoor radios shall:

1. Be new equipment.
2. Support operation in the 6 and 11 GHz bands.
3. Support channel bandwidths up to 60 MHz.
4. Operate to specification from 23°F to +131°F, and 5% to 95% humidity (non-condensing).
5. Have an RF transmitter switch.
6. Have a transmit monitor port for in-service maintenance.
7. Provide built-in waveguide expansion ports to allow multiple RF signals to operate on a common waveguide/antenna.
8. Include a calibrated transmit monitor port on the antenna coupler unit (ACU) for power and spectrum measurement purposes.

3.4.4 Microwave Indoor Units

A. Microwave radio indoor units (IDUs) shall be new equipment and provided with all split-mount and all-indoor radios. IDUs shall:

1. Be equipped with all cards/modules required to provide a complete and functional system, supporting all radio paths, and existing and future traffic, as specified herein. All plug-in interface cards shall be hot-swappable
2. Include primary and backup controller cards/modules
3. Have at least one unused slot for additional interface cards in the future

4. Have a minimum of two DS1 ports
5. Have a minimum of two small form factor pluggable (SFP) 10 GE ports
6. Have a minimum of eight 10/100/1000 BaseT Ethernet ports
7. Have a minimum of six alarm inputs and six alarm outputs

B. Ethernet cards/modules/ports shall support:

1. IEEE 802.3x, Flow control
2. IEEE 802.1Q, VLAN tagging
3. IEEE 802.1ad, Stacked VLAN
4. E-Line (point-to-point) and E-LAN (multipoint)
5. Rate limiting on a per-port basis, to limit the data rate
6. IEEE 802.1AX, Link Aggregation
7. 802.3 10BaseT and 802.3u 100BaseTX
8. IEEE 802.3z 1000BaseSX/LX
9. Quality of service (QoS) and priority classification
10. IEEE 802.3ag, Ethernet Service OAM and IEEE 802.3ah, Ethernet Link OAM

3.4.5 Microwave Radio Antennas

A. Microwave radio antennas shall:

1. Be compatible with the radio frequency bands used and conform to applicable FCC requirements
2. Be solid, parabolic, Category A antennas with radomes in accordance with FCC Part 101.115. Shielded antennas shall be used as required by frequency coordination
3. Be of size and type to meet the specified path availability requirements
4. Shall be equipped with two azimuth/stabilization rods for 8-foot diameter antennas or larger and one for 6-foot diameter antennas, tying the antenna rim to the tower steel (not tower cross members); Azimuth/stabilization rods are not required for 4-foot diameter and smaller antennas

B. Split-mount Microwave antenna systems shall utilize:

1. Mounting hardware designed specifically for the size and type of antenna mount structure, and the type of antenna used; make and model numbers

for all antenna mount hardware shall be provided to the City for approval prior to beginning installation

2. Ethernet or fiber for connection between antenna and microwave radio to minimize weight and stress on the tower structure

C. All-indoor Microwave antenna systems shall utilize:

1. Pressurized elliptical waveguide for the antenna to all indoor mount radios; connectors shall be standard, premium type, and compatible with the antenna

2. Solid corrugated copper outer conductor coaxial cable for split and all-outdoor mount radio configurations

D. Contractor shall furnish a dehydrator/pressurization system at sites with full-indoor microwave radios that is:

1. Capable of maintaining at least 5 pounds per square inch gauge (psig) positive pressure of conditioned air in the elliptical waveguide; individual pressure gauges with valves on a distribution manifold shall be provided for each transmission line

2. Manually adjustable without the need for software or removable media

3. Equipped with a run alarm and high and low-pressure alarms

4. Site Development

4.1 Existing Site Improvements

A. The Contractor shall leverage existing site infrastructure to the extent possible including buildings/shelters, tower structures, primary and backup power systems, and heating, ventilation, and air conditioning (HVAC) systems.

B. Contractor shall be responsible for site improvements based on deficiencies discovered through the site surveys.

C. Where the Contractor selects existing site(s), the requirements for the equipment rooms shall be functionally the same as for new equipment shelters and meet current industry standards for uninterruptible power supplies (UPS), lighting, HVAC, site alarms, grounding, backup power generator (or second source AC power), and security. Contractor shall state where equipment rooms are included in their system and provide details on the equipment room design. Contractor shall state how the equipment rooms in their design functionally meet the requirements, as well as industry standards.

D. Contractor shall provide a grounding audit for each site detailing required modifications to bring site up to Contractor selected grounding specification from Section 1.1.3.B.

E. For all sites where an existing equipment room is not sufficient to accommodate the new radio equipment in accordance with current industry site standards, the Contractor shall provide new equipment shelters. Contractor shall state where new equipment shelters are included in their design.

F. Contractor shall verify that all sites selected for use have sufficient space available for antenna and ancillary equipment to be mounted on the tower/structure. In the event a Contractor selects a location on the tower/structure that is not available, the guarantee of coverage shall not change even though an alternative design may be required.

G. Contractor, prior to detailed design, shall perform structural analyses on all existing sites selected for their design. If no current drawings are available, the Contractor shall also be responsible for any tower mapping services required for the structural analysis.

1. Structural analysis shall be performed on existing towers and foundations according to the ANSI/TIA-222 standard, latest version applicable at time of structural analysis
2. Structural analysis shall include existing and proposed equipment; however, it is the City's intent that the Contractor remove unused system equipment once cutover and acceptance of the System is completed
3. Structural analysis reports shall be provided to the City upon completion of study or studies
4. In the event a tower and/or foundation fails the structural analysis, the Contractor shall be responsible for modifying them to correct the deficiencies. A passing structural analysis report shall be provided to the City detailing the tower modifications

H. In the event that an existing commercial tower location is selected, the Contractor shall provide the City with lease costs for tower space and ground space required to support the new radio and backhaul systems. Additionally, the Contractor shall exercise due diligence to verify availability of the tower elevations proposed and that the tower can support the new equipment.

I. Contractor shall identify and propose any additional work necessary to make existing City owned and non-City-owned sites and infrastructure usable in the new System.

J. Contractor shall replace all HVAC equipment at existing City owned sites.

K. Contractor shall be responsible for updating all existing sites that are part of the new System to be compliant with their selected grounding and lightning protection standards. Contractor shall be accountable for updating all deficient site conditions.

L. Contractor shall be responsible for completing any documents required by local, state and federal departments including, but not limited to permitting documents and State Historic Preservation Office (SHPO) forms.

M. Contractor shall be responsible for any issues related to site selection and will be responsible for resolving any issues related to site permitting or zoning.

N. Code Compliance:

1. Installation of all electrical equipment, power distribution, lighting assemblies and associated wiring shall comply with the most recent edition of the

National Electric Code (NEC) and Occupational Safety and Health Administration (OSHA) regulations

2. All electrical equipment shall be listed or approved by Underwriters Laboratories (UL)
3. Contractor and their subcontractor(s) shall comply with all applicable local codes as well as industry best practices and guidelines stipulated in Section 1. 1. 3, Standards and Guidelines

O. Contractor shall assume total responsibility for maintaining liability insurance covering the following items:

1. Project design
2. Implementation
3. Licensing
4. Shipping
5. Receiving
6. All site work required
7. Any items required for the Contractor or any required subcontractors

P. Contractor shall coordinate with utility companies for all utility related items, such as electrical service hookups and disconnects.

4.2 Direct Current (DC) Power Requirements

A. For the purpose of initial design, the Contractor shall assume that a new DC power system is required for all sites (new or existing).

B. The DC power system shall be designed to meet the specific load requirements for all Contractor-furnished equipment at each site and include enough capacity for an additional future load of 25% of the equipment furnished under this contract.

C. The power supply/charger shall be the primary power source and shall also charge the backup batteries.

D. Transfer to the batteries upon Alternating Current (AC) power failure shall be automatic.

E. Upon restoration of primary AC power, the power supply/charger shall become the primary power source again and begin recharging the batteries.

F. The DC power system shall provide the following alarms to the NMS alarm system:

1. Rectifier failure
2. AC power failure
3. Low current
4. Battery low voltage
5. DC breaker
6. Generator Run
7. Generator Fail Alarm
8. Generator Maintenance Due

G. The DC power system shall perform as specified herein when housed with or adjacent to other radio transmitters operating in accordance with FCC regulations.

H. All load current shall pass through a single main distribution breaker prior to sub-panel breaker/fuses and individual load breaker/fuses. An individual assigned breaker/fuse shall be employed for each specific communication device powered.

I. The power supply/charger shall meet the following requirements:

1. Input Voltage: single phase, 208/240 or 120 VAC +/- 10%
2. Frequency: 60 Hz +/- 5%
3. Output Voltage Range: -42 to -56 VDC (positive ground)
4. Float Voltage: 50.9 - 54.0 VDC
5. Equalize Voltage: 54.2 - 57.6 VDC
6. DC Output Voltage Regulation: +/- 0.5% from no load to full load
7. Output Current: As calculated to support load requirements
    a. Minimum 12 Amps
    b. Full recharge of batteries shall be accomplished within eight hours
8. Output noise shall not degrade the performance of LMR equipment in the vicinity of the power supply/charger
9. AC to DC conversion efficiency shall not be less than 75%
10. Shall include equalize circuitry and controls for periodic manual equalization of batteries as needed

11. Shall be 19-inch rack mountable
12. Shall be equipped with an input power AC circuit breaker, output power DC circuit breaker, DC current meter and DC voltage meter
13. Shall be initially configured for independent operation, however, shall be capable of operating in parallel with another power supply/charger in the future, without damage to either unit
14. Shall provide separate adjustable voltages for floating and equalizing of the batteries, with the voltages initially adjusted to accommodate the batteries provided
15. Shall include short circuit current protection and high voltage shutdown circuitry
16. Each alarm shall include a Form “C” contact for connection to an external alarm, and the alarm status shall be displayed on the front panel of the power supply/charger

J. The batteries shall:

1. Be designed for float connection in support of continuous steady current loads with battery discharge only during loss of charger/power-supply output
2. Be sized to support full load operation for a minimum of 10 hours
3. Include support trays for installation inside the communication cabinets
4. Include all cell interconnect bus pieces and hardware
5. Be sealed, lead acid batteries requiring no maintenance
6. Have a minimum expected service life of 10 years, defined as the time in which the battery capacity drops below 80% of the original capacity

K. Other DC Power System Components:

1. Load distribution/disconnect panels shall:
   a. Include individual 100 Amp circuit breakers for protecting and/or disconnecting each charger/battery bank from the load
   b. Include a front panel LED display indicating whether a breaker has been tripped
   c. Include a Form “C” relay for connection to an external alarm panel. The relay shall be activated if any breaker trips or is shut off
   d. Be 19-inch rack mountable

2. Circuit breaker panels shall:
    a. Include circuit breakers, appropriately sized for disconnecting the individual loads
    b. Be 19-inch rack mountable
    c. Include a minimum of five spare circuit breakers, with a minimum current rating equal to the circuit breaker for the installed load
3. The negative and positive bus bars shall:
    a. Be 19-inch rack mountable
    b. Be equipped with standoffs that will electrically isolate it from the mounting rack inside the cabinet
    c. Be solid copper, sized to handle the required current capacity
4. DC power cables shall be of appropriate size to handle the load current requirements, as specified

L. Contractor shall provide all miscellaneous parts, not otherwise specified, but are required to interconnect all the equipment and parts specified.

4.3 Uninterruptible Power Supply Requirements

A. Contractor shall supply a new Uninterruptible Power Supply (UPS) for all City owned sites and new sites.

B. Contractor shall supply a new UPS for existing sites based on the deficiencies discovered through the site surveys.

C. Contractor may recommend re-use of existing UPS based on findings from their site surveys. The City shall approve re-use of any existing UPS.

D. Contractor shall provide single phase, online, double conversion, static type, UPS with the following features:

1. Direct dedicated connection to main panel
2. Surge suppression
3. Input harmonics reduction
4. Rectifier / charger
5. Inverter
6. Static bypass transfer switch

7. Battery and battery disconnect device
8. Internal maintenance bypass / isolation switch
9. Output isolation transformer
10. Equipped with NIC and be alarmed through NMS
11. Remote UPS monitoring provisions
12. Battery monitoring
13. UPS output shall be connected to a dedicated subpanel feeding quad 20A twist lock outlets to be installed on the overhead cable tray

E. Operational Requirements:

1. Automatic operation includes the following:
    a. Normal Conditions – Load is supplied with power flowing from the normal power input terminals, through the rectifier-charger and inverter, with the battery connected in parallel with the rectifier-charger output.
    b. Abnormal Supply Conditions – If normal supply deviates from specified and adjustable voltage, voltage waveform, or frequency limits, the battery supplies energy to maintain constant, regulated inverter power output to the load without switching or disturbance.
    c. If normal power fails, energy supplied by the battery through the inverter shall continue to supply regulated power to the load without switching or disturbance.
    d. When power is restored at the normal supply terminals of the System, controls automatically synchronize the inverter with the external source before transferring the load. The rectifier-charger then supplies power to the load through the inverter and simultaneously recharges the battery.
    e. If the battery becomes discharged and normal supply is available, the rectifier-charger charges the battery. On reaching full charge, the rectifier-charger automatically shifts to float-charge mode.
    f. If any element of the UPS system fails and power is available at the normal supply terminals of the System, the static bypass transfer switch switches the load to the normal AC supply circuit without disturbance or interruption.
    g. If a fault occurs in the System supplied by the UPS, and current flows in excess of the overload rating of the UPS system, the static bypass

transfer switch operates to bypass the fault current to the normal AC supply circuit for fault clearing.

h. When the fault has cleared, the static bypass transfer switch returns the load to the UPS system.

i. If the battery is disconnected, the UPS continues to supply power to the load with no degradation of its regulation of voltage and frequency of the output bus.

2. Manual operation includes the following:

a. Turning the inverter off causes the static bypass transfer switch to transfer the load directly to the normal AC supply circuit without disturbance or interruption.

b. Turning the inverter on causes the static bypass transfer switch to transfer the load to the inverter.

3. Controls and Indications:

a. Basic system controls shall be accessible on a common control panel on the front of the UPS enclosure.

F. Performance Requirements:

1. Input:

a. Single phase, three-wire

b. Voltage: 120/240 VAC Nominal

c. Frequency: 50/60 Hz +/- 3 Hz

2. Output:

a. Voltage: 120/240 VAC

b. Frequency: 60 Hz, +/- 3 Hz

c. Maximum Voltage Distortion: 5% at full load

d. Minimum 30-minute battery operation

4.4 Equipment Shelter

Contractor shall supply a new equipment shelter for new and/or existing sites as required by their design and as permissible per the site owner. If new the following specifications shall apply.

4.4.1 Shelter Size

A. The shelter size shall be 12’ x 16’ exterior, with a minimum interior height of 9’, unless otherwise waived by the City.

B. Shelter dimensions shall accommodate legacy and new equipment with enough room to expand the usable rack footprint by 40%.

4.4.2 Shelter Design and Construction Requirements

A. Where possible, the shelter shall be a prefabricated, preassembled concrete shelter.

1. If any site will not accommodate the prefabricated shelter, the City will consider site assembly and other shelter types.
2. Contractor is responsible for all costs, permits and approvals required to transport the shelter to the site and for assembling and constructing the shelter at the site.

B. In addition to all applicable codes and standards, Contractor shall design the shelter to meet or exceed the following structure requirements:

1. 200 pounds per square foot distributed floor loading while on foundation
2. 125 pounds per square foot distributed floor loading while lifting
3. 200 pounds per square foot minimum roof load and a concentrated load of at least 500 pounds per square foot
4. Minimum wind requirements as specified in TIA 222 Standard, current revision, for the local zone
5. Seismic Design Category D
6. Vents and entryways shall be constructed to deter vandalism
7. Vents and entryways shall be constructed to prevent entry of rodents
8. Waterproof

4.4.3 Exterior Finish

The exterior finish of the shelter shall be exposed aggregate.

4.4.4 Bullet Resistance

Shelter walls shall be capable of stopping 30.06 rifle fires per UL 752 requirements.

4.4.5 Fire Rating

Shelter walls shall provide a two-hour fire rating.

4.4.6 Insulation and Interior Finish

A. Walls and ceiling shall be insulated to a minimum value of R-11.

B. Interior walls and ceiling shall be sheathed with ½ inch white Nu-Poly® or similar board.

C. Shelter walls shall be reinforced as required to support wall mounted equipment.

D. Floor will be covered with light colored industrial grade vinyl tile floor covering.

4.4.7 Exterior Door

A. The shelter shall be equipped with a 42-inch by 84-inch door.

B. The door shall have a bullet resistance rating that complies with levels 1-4 of UL 752 ballistic standards.

C. Door, frame and frame components shall be painted or otherwise treated to be rust-proof.

D. Each door shall as a minimum be equipped with the following hardware and accessories:

1. A continuous stainless-steel hinge the entire length of the door
2. Neoprene weather strip
3. High security locking cylinder latch set
4. Mortised dead bolt
5. Anti-pick plate on strike of door to restrict access to the latch and deadbolt
6. Hydraulic closer
7. An exterior mounted canopy to protect the door entry shall be designed to support a load of 100 pounds per square foot

4.4.8 Power Distribution

Power distribution shall include the following:

A. One metal oxide varistor (MOV) / silicon avalanche suppression diodes (SASD) lightning arrestor, Type 1

B. One MOV lightning arrestor, Type 2

C. One 60 Amp enclosed circuit breaker for safety disconnect of Transient Voltage Surge Suppressor (TVSS) unit

D. One 200 Amp, 10,000 AIC, 120/240 VAC, single phase, 60 Hz, 30 space main breaker, snap-in utility power distribution panel, in a NEMA 1 surface mount enclosure

E. Circuit breakers for all communications system equipment and customer loads as specified

F. One 200 Amp, 240 VAC, fused, double pole, single throw safety switch

G. One 200 Amp, 240 VAC, non-fused, double pole, double throw manual transfer switch

H. One 200 Amp, four-pin, reversed service exterior power receptacle

I. Six 20 Amp specification grade duplex receptacles

J. One 20 Amp specification grade exterior ground fault duplex receptacle

K. Ten 20 Amp ceiling or cable tray mounted NEMA twist-lock receptacles with matching plugs

L. All wiring shall be installed in surface mounted conduit or NEMA wire ways and be in full compliance with the latest version of NFPA 70, National Electrical Code

4.4.9 Lighting

A. Equipment shelter lighting shall be energy efficient and generate low heat levels. Acceptable lighting shall be long lasting energy efficient technologies, such as light emitting diodes (LED) or fluorescent.

B. Equipment shelter lighting shall comply with the most current version of U.S. defense standard MIL-STD-461 for low radio frequency interference (RFI) lighting fixtures.

C. There shall be sufficient interior lighting to provide a level of 540 Lux (50-foot candles at 1 meter (39.4 inches) above the equipment shelter floor. Refer to the most current version of the TIA-569 standard for additional information.

D. Placement of equipment shelter lighting shall assure illumination in front of and behind tall equipment racks (within aisle ways; not directly above equipment racks).

E. Light fixtures shall employ earthquake bracing.

F. Interior lighting control switches shall be located near the non-hinged side of the entrance door to the equipment shelter. One switch shall control a single lighting fixture and the second switch shall control the remaining lighting fixtures. Refer to the latest edition of NEC Article 410: Luminaries, Lamp Holders, and Lamps for additional information.

G. Interior emergency backup lighting units shall be installed and activate immediately upon failure of all AC power. The emergency backup lighting shall also be equipped with an illuminated "Exit" sign mounted above the exit door of the equipment shelter indicating exit locations in the equipment shelter during emergency evacuation.

H. Exterior lighting shall illuminate points-of-exit and entry into the site compound and the equipment shelter and be located to the side of the entrance way and above door level.

I. Each equipment shelter shall have light-emitting diode (LED) exterior lighting fixtures with cutoff housings that limit the beam top to 35˚ below horizontal, and protection from falling ice.

J. Each shelter shall have a combination photoelectric/motion switch that provides for automatic illumination at twilight or when motion is detected, and extinguishment of the exterior equipment shelter lights at sunrise.

K. Each exterior light equipped with a combination photoelectric/motion switch shall also have a photoelectric /motion bypass switch installed at the same location as the interior lighting control switches.

4.4.10 HVAC

A. HVAC at new sites shall be redundant wall mount air conditioning units, with low ambient and compressor anti-cycle controls, integral 5 kW resistance heat strips and washable dust filters.

B. Contractor will ensure HVAC is sized correctly with equipment heat loads and include the following features:

1. Redundant lead/lag controls allowing approximately equal operating time on each air conditioning unit

2. Active dehumidification controls that modulate heat and air conditioning operation to control high humidity conditions

3. One 650 cfm at 0" of H_2O static pressure exhaust fan system, including motorized intake and exhaust louvers, thermostat, fiberglass hoods, permanent expanded metal dust filter and exhaust insect screen

4.4.11 Site Alarms

A. Any change in the state of site equipment shall induce an alarmed state.

B. Equipment monitored shall include, but not be limited to the following:

1. Surge arrestors
2. Transfer switch (normal or bypass state)
3. Power fail
4. HVAC
5. Smoke detector
6. Intrusion detection
7. High temperature
8. Low temperature
9. High humidity
10. UPS/DC Power Plant fail
11. UPS state (normal or bypass)
12. Generator (generator run, low fuel, high temp, and fail)
13. Generator not in auto
14. Propane fuel level low
15. Tower lighting alarms
16. To reduce false alarms, all alarm contacts shall be normally closed when no alarm is present.

4.4.12 Grounding

A. Contractor shall follow industry standard best practices for the grounding and bonding of the building, electrical service, tower, cable trays, transmission line entrance portal, and all equipment and other structures, that the City will pre-approve. Contractor shall provide the standards documents to the City and include these documents in all site documentation.

B. The design goal for resistance of the ground system is 5 Ohms or less. If the design goal cannot be achieved, the Contractor shall identify supplemental grounding technique(s) for City review and approval.

4.4.13 Entry Ports

A. Cable entry ports shall consist of one 8-port entry panel with 4-inch sleeves and protective blank covers.

B. Contractor shall provide appropriately sized entry port boots to accommodate the proposed RF and backhaul cables.

C. Contractor shall ground the entry ports according to the grounding standard selected in Section 1.1.3.B.

4.4.14 Cable Ladder

A. Contractor shall supply and install up to 40 feet of 18-inch-wide cable ladder/tray.

B. Contractor shall ground the cable ladder/tray according to the grounding standard selected in Section 1.1.3.B.

4.4.15 Telco Board

If needed, the Contractor shall supply one 4-foot x 6-foot x ¾ inch Telco board(s).

4.4.16 Accessories

Contractor shall provide the following accessories at each new shelter:

A. One portable 10-pound CO_2 fire extinguisher

B. One handheld emergency eye wash station

C. One first aid kit

D. One service manual

E. One smoke detector

4.4.17 Drawings

A. Contractor shall provide two sets of shelter drawings with each shelter.

B. Contractor shall supply typical foundation drawings based on Presumptive Soil Parameters specified in the TIA -222 Standard, current revision.

C. Contractor shall validate all foundation design parameters and assumptions for the specific site prior to construction.

D. Contractor shall supply support calculations for recommended building tie down locations.

4.4.18 Generator Plug

A. The shelter shall include a wall penetration for exterior weatherproof generator plug, to accommodate the use of a mobile generator.

B. The location of the penetration and the type of exterior generator plug that is to be installed in the penetration will be coordinated with the City prior to manufacture of the shelter.

4.5 Site Generator

A. Re-use or replacement (may be required) of backup generator for all Dispatch, control (trunked and simulcast) and RF sites.

B. Contractor shall supply a new site generator for new sites that are part of their design.

C. Contractor shall supply a new site generator for new Greenfield sites. New sites shall be equipped with properly size genset fueled by 1,000-gallon LP tanks. Gensets and LP tanks to be monitored by NMS.

D. Contractor shall supply and install new generators that comply with the Outdoor-Use Units specifications in UL 2200, latest edition.

4.5.1 Power and Electric Requirements

Generator specifications include the following:

A. Fuel: Liquid Propane

1. Natural gas or diesel may be provided as an option

B. Output: 25 kW (minimum, and sized for the proposed system)

C. Phase: Single

D. Voltage: 120/240 VAC

E. Frequency: 60 Hz

4.5.2 Enclosure

The generator enclosure shall be outdoor weather protective and securely attached to a foundation designed to the generator manufacturer’s specifications.

4.5.3 Muffler Type

The generator muffler shall be of residential critical grade including flexible exhaust section.

4.5.4 Control Panel

A. The generator control panel shall be either analog or digital and capable of displaying the following:

1. Oil Pressure
2. Coolant temperature
3. Fuel level (where applicable)
4. DC battery voltage
5. Run time hours
6. Alarm Status

B. The generator shall be capable of providing, at a minimum, the following alarm status information:

1. High or low AC voltage
2. High or low battery voltage
3. High or low frequency
4. Low or pre-low oil pressure
5. Low water level
6. Low water temperature
7. High and pre-high engine temperature
8. High, low and critical low fuel levels (where applicable)
9. Over crank
10. Over speed
11. Unit not in “Automatic Mode”

4.5.5 Miscellaneous

A. Generator will be supplied with block heater, 10 Amp battery charger, and meet NFPA 110 requirements.

B. Fuel tanks shall be sized to accommodate for 120-hours run time with a minimum size of 1,000 gallons.

C. Contractor shall be responsible for generator installation, test, and first fill of all fuel tanks.

D. Fuel tanks shall be equipped with monitoring device capable of triggering an alarm contact upon low fuel. Low full threshold shall be programmable.

E. Fuel tanks shall be securely attached to a poured concrete foundation.

4.5.6 Automatic Transfer Switch (ATS)

A. Contractor shall install the ATS in the shelter prior to shelter shipment.

B. ATS shall include a programmable exerciser capable of automatic starting and shutdown of generator on a weekly basis.

C. ATS shall have a 200 Amp rating and enclosed in NEMA 1 enclosure.

4.6 Self-Supporting / Monopole Tower

A. Contractor shall leverage existing building rooftop structures to the extent possible.

B. Contractor shall supply and install the necessary hardware to mount the new antenna systems at the proposed sites and heights.

C. If required, the Contractor shall supply a new self-supporting tower for new and/or existing sites.

D. Contractor may recommend reuse of existing towers based on the site survey findings and structural analysis results. The City shall approve reuse of any existing tower structure.

E. Should a new tower structure be required at any site in the Contractor's design, it shall comply with the requirements of this section.

4.6.1 General

A. Contractor shall leverage existing building rooftop structures to the extent possible.

B. Contractor shall supply and install the necessary hardware to mount the new antenna systems at the proposed sites and heights.

C. If required, the Contractor shall supply a new self-supporting tower for new and/or existing sites.

D. Contractor may recommend reuse of existing towers based on the site survey findings and structural analysis results. The City shall approve reuse of any existing tower structure.

E. Should a new tower structure be required at any site in the Contractor's design, it shall comply with the requirements of this section.

4.6.2 Design Criteria

A. The design shall be based on the minimum wind and ice requirements as specified for Class III structures in TIA -222 Standard, current revision.

B. Each tower and foundation shall be designed for all equipment, appurtenances, ancillary equipment, antenna loading and include 25% future capacity.

C. The tower shall be manufactured as a self-supporting lattice or a monopole design.

D. All structural steel and hardware shall be galvanized after fabrication in accordance with the appropriate standards.

1. All tower materials shall be hot dip galvanized after fabrication; with a minimum zinc coating of 2 oz. per sq. ft.

2. Bolts shall be hot dip galvanized according to American Society for Testing and Materials (ASTM) A-325 or the latest version of this standard.

E. The make, model, serial number, and height of the tower shall be clearly labeled at the base of the tower. Labeling shall be weatherproof and durable such as a stamped metal plate or equivalent.

4.6.3 Transmission Line Support

A. There shall be a ladder type support system associated with the tower to mount the transmission cables for radio antennas and microwave dishes.

B. In the case of a monopole, transmission lines will be routed internally. This support shall comply with tower and cable manufacturer's installation specifications.

C. The support system shall accommodate cable or waveguide mounting hardware at the proper intervals.

D. The support shall be equipped with precision punched or drilled holes to allow installation of snap-in type or bolt-in hangers.

E. The support system shall be sized for 25% growth beyond initial system implementation.

F. The support materials will be of similar construction as other tower materials to appear integral to the structure.

G. The support shall be designed to meet rigidity specifications similar to the tower.

4.6.4 Ice Bridge

A. The tower shall be equipped with an ice bridge with support posts spaced at intervals compliant to the wind loading specifications, but no greater than 10 feet apart.

B. There shall be posts placed on both lateral sides of the bridge to fully support the load.

C. The bridge shall be designed to support all initial antenna transmission lines plus 25% growth capacity.

D. The structure shall comply with the tower wind and ice requirements as specified in TIA -222 Standard, current revision.

E. Contractor shall furnish and install the ice bridge between the tower and equipment shelter.

F. The following criteria shall govern the design of the waveguide bridge:

1. Structurally sturdy to support live and dead loads
2. Free standing (i.e., not attached to the shelter or tower)
3. Minimum width of 2 feet
4. Length/height as required by the site specifics
5. Bridge/ice shield material shall be fabricated from galvanized bar grating or approved equivalent
6. All components of the waveguide bridge shall be hot-dipped galvanized after fabrication
7. Posts shall have galvanized caps
8. Posts shall be set in concrete foundations.
9. Each post shall be separately grounded to the site ground system with 1/0 AWG stranded bare copper conductor
10. Ice bridge shall be adjustable in height to allow interface with shelter waveguide entry ports
11. Ice Bridge shall be effectively grounded to the external ground bar

4.6.5 Climbing Equipment

A. The tower shall be equipped with an approved climbing ladder and safety device.

   1. The ladder may be integrated into the structural components of the tower.

B. There shall be a climbing safety system compliant to original manufacturer's specifications.

C. The equipment shall comply with TIA-222, current revision.

4.6.6 Lighting System & Control

A. A lighting system is not required by the FAA for towers under 200 feet. However, due to the proximity of sites to an airport the FAA may require the installation of a lighting system.

B. Contractor shall furnish and install an obstruction lighting system approved by the FAA and compliant with applicable standards.

C. The lighting system shall include:

   1. Controller
   2. Lamps
   3. Lightning protection
   4. Mounting hardware
   5. SO service cabling (Service Cord 600 Volts, Oil Resistant Outside Jacket)
   6. Wiring
   7. Other material required for a complete installation

D. The lighting system shall be controlled by a 120-volt AC, single-phase solid-state control unit and power supply.

E. The control unit shall be installed within a NEMA 3R metal cabinet or a NEMA 4X cabinet. The control unit shall be mounted inside the equipment shelter.

F. The lights shall be automatically controlled by means of a photoelectric unit. The control unit shall be designed with relays for:

   1. ON-OFF status of lights
   2. Control unit failure
   3. Light failure

G. The lighting system shall automatically revert to back-up power source upon loss of primary power

1. The lighting system shall automatically reset upon power restoration of primary power.

H. The controller shall include a test switch allowing simulation of daytime and nighttime modes.

I. All levels of lighting shall be clearly visible from any direction of approach to the tower.

J. The photoelectric unit shall be installed in a moisture-proof protective metal or high impact plastic housing.

K. The photoelectric unit shall be installed on the building in an inconspicuous location and adjusted to attain an unobstructed view of the sky.

L. The photocell shall be mounted such that it is not affected by artificial light.

M. Photocell wiring shall be installed entirely within rigid galvanized conduit.

N. Ice shields shall be installed for all lighting system fixtures except for the topmost light.

O. The controller case shall be grounded to the equipment shelter building ground with #4 AWG or larger copper wire.

5. System Implementation, Test and Acceptance

5.1 Project Management

A. Contractor shall schedule and conduct project and construction meetings on a regular basis throughout the entire implementation of the System. Additional meetings may be scheduled at the discretion of the City.

B. If any changes in the overall timeline occur, the Contractor shall update the project schedule for discussion during these project meetings.

C. Contractor shall provide written minutes of all meetings no later than five business days after the meeting.

5.1.1 Project Staffing

A. Contractor shall provide the appropriate project staff based on workload and the level of effort required throughout the implementation/installation process.

B. The staff identified in the Contractor's proposal, shall serve the duration of the project unless the Contractor proposes an alternative plan to the City for consideration and gains approval.

C. The City reserves the right to accept or reject any proposed staffing changes.

D. Contractor shall assign a Project Manager to be the primary point of contact between the City and the Contractor.

E. The Project Manager shall have the following experience:

1. Have managed and successfully completed (system was accepted) at least one public safety radio project of at least $5 million
2. Experience in telecommunication site development and construction
3. Ten years or more experience as a project manager implementing telecommunications projects
4. Be an employee of Contractor as a lead project manager for a period of one year or more

F. The Project Manager shall be fully responsible for:

1. Supervising and coordinating the installation and deployment of the communications system
2. Development and acceptance of the project management plan
3. Managing the execution of the project against that plan

4. Overseeing the day-to-day project activities, deliverables, and milestone completion
5. Coordinating, and facilitating weekly and monthly status meetings
6. Establishing, managing, and providing access to an online collaboration platform for the duration of the project for uploading and downloading of all system documentation and project submittals
7. In the file sharing platform, folder structure(s) shall be consistent for all sites so that similar files can easily be found and retrieved

G. During implementation, the Project Manager shall be on-site at a project related location within the City 40 hours per week.

H. The Project Manager shall have the authority to make business decisions that are binding for the Contractor.

I. Contractor shall assign a Project Engineer for the duration of the project responsible for design, engineering, and testing of the System and subsystems.

J. The Project Engineer shall have the following minimum qualifications:

1. Ten years' experience in configuring Public Safety radio communication systems
2. Ten years' experience in configuring P25 systems
3. Full time employee of the Contractor as a Lead Engineer for three or more years

K. The Project Engineer shall be responsible for the following:

1. Requesting and reviewing existing documentation to understand the City's existing radio systems, backhaul network, dispatch center, site infrastructure, and equipment inventory
2. Managing the System design and ensuring system installation and testing in accordance with the approved system design; any deviation from the proposed system design shall be subject to project change control procedures and will not be undertaken until approved by the City
3. Ensuring the accurate development of block diagrams, system-level diagrams, and rack diagrams
4. Leading and supervising the development and execution of:
    a. Site Survey Reports
    b. Structural Analysis Reports
    c. Detailed Design Packages

d. All Test Plans, including Factory, Coverage, and Final ATP

e. Fleet Mapping Plan

f. Migration/Cutover Plan

L. The Project Engineer shall guide the project team through the processes and procedures necessary to prove that the System and subsystems perform as specified in the contract.

M. The City shall approve all test plans prior to execution. The City or City's representative shall witness execution of all test plans.

5.1.2 Scheduling

A. Contractor shall develop and maintain a project schedule including tasks, milestones, start and end dates, task predecessors, and task owners based on an approved work breakdown structure (WBS).

B. The schedule shall represent tasks associated with completing work on all items identified in the WBS.

C. Contractor shall update the project schedule with actual dates as tasks are completed.

D. Contractor shall present all schedule updates to the City during the weekly status meetings.

E. Contractor shall present, at a minimum, the following schedule metrics in the weekly status meetings:

1. Completed tasks
2. Past due tasks
3. Baseline Execution Index (BEI)
4. Finish variance
5. Critical path
6. 4-week forecast

F. The schedule shall address the following tasks and milestones at a minimum:

1. Site surveys
2. Detailed design review
3. Site preparation
4. Equipment order and manufacturing
5. Factory acceptance test

6. Equipment delivery
7. System installation
8. System configuration
9. System optimization
10. Acceptance testing
11. Coverage testing
12. User training
13. System cutover
14. System documentation development and delivery
15. System and equipment warranty

5.1.3 Project Meetings

A. Contractor shall schedule a project kickoff meeting prior to the beginning of the project.

B. Contractor shall schedule weekly and monthly project status meetings following contract award and the initial kickoff meeting.

C. Weekly and monthly status meetings shall continue throughout the duration of the project until the City issues final system acceptance.

D. Contractor shall conduct in-person quarterly project reviews with the City. Contractor shall have a senior executive at the corporate level in attendance at every quarterly project review.

E. Contractor shall be responsible for facilitating (meeting location and/or conference bridge) the weekly, monthly, and quarterly status meetings.

F. Contractor shall prepare and distribute meeting agendas and minutes to the City via e-mail on a weekly basis at a minimum two business days prior to each scheduled meeting.

G. Meeting agenda items shall include, as a minimum, the following items:

1. Schedule review
2. Status of deliverables
3. Risk items and planned responses
4. Proposed changes
5. Plans for the next period

6. Action item assignments
7. Punch list review

H. Contractor shall develop, update, and present a field tracker with site readiness and install status at each scheduled meeting.

I. Contractor shall develop, update, and present a monthly dashboard at each scheduled monthly meeting.

1. The dashboard shall serve as mechanism that allows the City to provide feedback on the Contractor's performance for the current month and project-to-date.
2. The City shall provide the Contractor with their feedback at a minimum two business days prior to each scheduled monthly meeting.
3. The dashboard shall contain, at a minimum, the following categories:
    a. Customer satisfaction
    b. Schedule performance
    c. Technical performance
    d. Staffing
    e. Quality
    f. Suppliers
    g. Site Civils/Remediation
4. The dashboard shall contain, at a minimum, the following ratings per category:
    a. Blue (Excellent)
    b. Green (Good)
    c. Yellow (Concerning)
    d. Red (Poor)
5. The dashboard shall have a section that allows the City to provide feedback (in narrative format) on their rating, highlighting issues / challenges of concern.
6. For categories that have ratings of Concerning or Poor, Contractor shall provide a plan of action (in narrative format) to return the rating to Good or better for each issue / challenge of concern identified by the City.

7. The dashboard may also serve for the Contractor to highlight major tasks / milestones completed and/or significant improvements for the current month and project-to-date.

5.1.4 QA/QC Plan

A. Contractor shall submit a project quality assurance/quality control (QA/QC) plan for review during detailed design.

B. The QA/QC plan shall address all stages of the project, including, but not limited to:

1. Procurement
2. System design
3. Installation
4. Implementation
5. Testing
6. Cutover

C. The QA/QC plan shall:

1. Describe the plans and procedures that ensure compliance of the proposed system design with the RFP requirements
2. Be included in the project management plan developed by the Project Manager
3. Be an integral part of the project
4. Include the City personnel as part of the review and approval process for all deliverables and submittals
5. Address the following project tasks at a minimum:
    a. Design analysis and verification
    b. RF coverage analysis and verification
    c. Design changes and document control
    d. Material ordering, shipping, receiving, and storage
    e. Site preparation (if required)
    f. Field installation and inspection
    g. Equipment inventory and tracking
    h. System testing and validation

i. Software regression testing

j. Deficiency reporting and correction

k. Implementation and cutover

l. Training and certification

D. All project submittals including but not limited to DDR packages, coverage maps, as-built drawings, test plans, migration plan, and project schedule should pass through System Assurance group/manager prior to City review.

5.1.5 Project Punch List

A. Contractor shall establish and maintain a punch list, as mutually agreed to with the City. The punch list shall be maintained in real time.

B. The punch list shall address all open issues including those related to sites, facilities, equipment, and acceptance tests.

C. Contractor shall distribute the punch list to the City weekly via e-mail.

D. The punch list shall include the following at a minimum:

1. Sequential punch list item number
2. Date identified
3. Item description
4. The party responsible for resolution
5. Expected resolution date
6. Resolution date
7. Details about how each punch list item was resolved and tested
8. Notes about the item

E. If the Contractor receives written permission from the City to transfer the responsibility of an item to another person or group, the Contractor shall add a new entry to the punch list and appropriately note the original entry.

F. Contractor shall be responsible for reviewing each punch list item and advising the City of any changes.

G. Contractor shall update the status of punch list items during each weekly status meeting.

5.1.6 Change Management

The change management process will conform to the process specified in the Contract.

5.2 Background Checks/Site Access

A. Contractor shall be required to authorize the investigation of its personnel, subcontractors, independent contractors, Subject Matter Experts (SMEs), etc., that shall have access to non-public areas of local, state, or Federal facilities, radio systems, network, data, or other sensitive information.

B. The scope of the background check is at the discretion of the City. The decision of the City is final.

C. Work performed within a Corrections Institution and/or Detention Center by Contractor employees may require additional site access conditions, work procedures, access and security measures including a background check and verification that shall be adhered to.

5.3 Frequency Coordination and Licensing

A. The System shall leverage the City's current UHF licenses, with additional frequency research, coordination, and licensing if needed to support all proposed channels and sites.

B. The City prefers the use of their currently licensed frequencies. Contractor shall identify, coordinate, and assist with licensing additional UHF channel(s) needed for the System.

C. Contractor shall identify, coordinate, and assist with licensing microwave backhaul frequencies needed for the System.

D. The City will retain their existing VHF licenses for other purposes but not for the proposed P25 System.

E. Contractor shall be responsible for the following tasks:

1. Provide all FCC and frequency coordination modifications and applicable forms to the City for review and approval following approval of the detailed design.
2. Complete all engineering tasks required for channel search/identification, coordination and licensing of all new LMR and microwave channels and the modification of existing licenses, which are required for the new system, including the completion of all forms and submission of license applications to the FCC.
3. Track all applications and filings with the selected frequency coordinator and/or the FCC
4. Respond to any questions by the selected frequency coordinator and/or the FCC regarding all applications and filings

5. Correct and resubmit any applications or filings by the selected frequency coordinator and/or the FCC for the modification of licenses or re-licensing of existing channels at no additional cost
6. Complete Federal Aviation Administration (FAA) forms as necessary
7. Complete all required FCC construction deadline notifications
8. Ensure compliance with the FCC's Maximum Permissible Exposure (MPE) requirements
9. Provide copies of each radio system and microwave backhaul license to the City

5.3.1 Intermodulation Interference

A. Contractor shall analyze all transmitters at each site for intermodulation interference, considering transmitting equipment from all tenants located at the sites as identified in FCC license information.

B. If the Contractor identifies an intermodulation problem prior to, during, or up to System Acceptance, the Contractor shall resolve the issue without degrading system coverage or performance.

C. Contractor-supplied transmitters at each site shall meet FCC Maximum Permissible Exposure (MPE) limits (per latest revision of FCC Office of Engineering and Technology (OET) Bulletin 65).

D. Contractor shall be responsible for controlling exposure to RF fields as stated in Section 4 of the FCC OET Bulletin 65:

1. Public Exposure: Compliance with General Population/Uncontrolled MPE Limits
2. Occupational Exposure: Compliance with Occupational/Controlled MPE Limits

E. Fencing, signage, and/or other techniques shall be approved in advance by the City.

5.4 Site Surveys

A. Contractor shall participate in a mandatory site survey with the City to confirm actual equipment location within each space prior to the start of the System installation. The City acknowledges potential for post-contract change orders but is relying on the Contractor's expertise to mitigate risk.

B. During the site survey, the Contractor shall determine and document any site changes needed to be included in the detailed design installation drawings. All

detailed design drawings and documents requiring changes after Detailed Design Review shall be revised and approved by the City prior to installation.

C. Contractor shall visit all sites to:

1. Assess site, safety, and access conditions
2. Verify work to be completed, including location of equipment and installation requirements
3. Assess the condition of existing radio shelters, radio towers, power systems, standby power systems, cable and waveguide routing, earthquake bracing, site grounding and lightning protection systems, and all other installation practices, to assure that they adhere to industry standard(s).
4. Identify existing City equipment that can be reused on the System

D. Upon completion of the site surveys Contractor shall produce a Site Survey report for each site, including, at a minimum:

1. Cover page with site name, date of survey, survey team member(s), and general site description
2. Accurate site coordinates (latitude/longitude) using Datum WGS84, preferably near the tower or antenna structure of interest
3. Photographs (submitted in .jpeg format using the naming convention “site name photo description date.jpg”) of:
    a. Overall site, showing location of radio tower(s) and equipment shelter(s)
    b. The radio tower(s)
    c. Antennas to be used for this project or location for new antennas
    d. Radio shelter exterior
    e. Inside of equipment shelter, including front and rear of existing radio equipment to be removed
    f. Coaxial cable and waveguide routes
    g. Rack location and position(s) where new equipment will be installed
    h. DC panel indicating breakers to be used
    i. Dehydrator unit and distribution manifold
    j. Feedline entry (inside and outside of shelter)
    k. Grounding and lightning protection systems

l. If applicable, solar power energy system, including panel arrays, charge controller, and batteries

m. If applicable, wind power energy system, including blades and mounts, charge controller, and batteries

4. Potential obstructions at or near the site that could impede radio paths and/or radio coverage, including type, and approximate azimuth and height

5. A list of existing equipment that can be reused for the System

6. A list of issues encountered or identified and proposed solution(s) for each deficiency

7. A statement of the work to be completed for system implementation and the method to complete the work

8. Recommended site upgrades, including, but not limited to equipment shelter, radio tower, antenna, waveguide, AC or DC power system, backup generator(s), UPS system(s), site access and physical site security

9. Accurate drawings of the shelter/equipment room in PDF and native format (i.e., Visio, AutoCAD)

10. Tower mapping with complete inventory of tower appurtenances, including antenna type, manufacturer, model number, height, weight, tower leg, azimuth, and transmission line type and size

E. Contractor shall produce a Grounding Assessment report for each site, based on industry standard(s). The report shall include at a minimum:

1. Cover page with site name, date of survey, survey team member(s), general site description, and selected standard(s) name and revision

2. Accurate site coordinates (latitude/longitude) using Datum WGS84, preferably near the tower or antenna structure of interest

3. Photographs (submitted in .jpeg format using the naming convention “site name photo description date.jpg”) of:

a. AC utility service grounding

b. Site ground ring (tower and shelter)

c. Ground rod test well(s)

d. Tower grounding (each leg)

e. Tower ground bar(s)

f. Tower guy wires
g. Transmission line grounding kits
h. Ice bridge grounding (all sections and legs)
i. Exterior ground bar(s)
j. Exterior RF entry port grounding
k. Interior RF entry port grounding
l. Interior halo grounding
m. Interior master ground bar(s)
n. Secondary ground bar(s)
o. RF surge suppressor grounding
p. Equipment rack grounding
q. Cable ladders and trays
r. DC power systems
s. AC surge suppressors
t. Generator grounding
u. Fuel tank grounding
v. Fence(s) and gate(s)
w. Other nearby metal objects

4. Clamp-on meter measurements (in Ohms) for each component assessed per the selected standard(s)
5. A list of existing grounding equipment that can be reused for the System
6. A list of issues encountered or identified and proposed solution(s) for each deficiency
7. A statement of the work to be completed for system implementation and the method to complete the work
8. List of site upgrades, including recommended or optional requirements specified in the selected standard(s) for compliance with industry best practices

5.5 Microwave Path Design

A. Contractor shall conduct physical path surveys to identify type, location and height of potential path obstructions for verifying path clearance and performing path calculations.

B. Contractor shall perform an independent analysis of all new microwave links and existing microwave radio links that will be replaced to ensure that they will meet the path availability requirements.

5.6 Detailed Design

A. Contractor shall submit the Detailed Design package within 90 calendar days after contract execution.

B. The Detailed Design package shall be inclusive of all sites in the System design, including but not limited to, system control site(s), simulcast site(s), standalone / repeater site(s), backhaul site(s), and PSAP/Dispatch site(s).

C. The Detailed Design package shall include the following items:

1. Any updates to previously submitted design information
2. A detailed description of the new LMR system, including the function of all equipment and how they interact to meet the requirements of this RFP
3. System block diagrams
4. Radio channel/frequency plan(s)
5. Radio coverage maps
6. Bandwidth requirements and calculations
7. IP addressing scheme and plan
8. Backhaul network diagrams showing the physical relationship and connectivity between the sites
9. Migration/Cutover Plan shall meet the following requirements:
    a. Migration/Cutover Plan shall describe in detail how the radio system will be phased over into a fully operational system
    b. Migration/Cutover Plan shall include the schedule and procedures associated with the transition of each operational user group. The plan shall specifically address how the existing users will begin using the System with minimal operational impact

c. Migration/Cutover Plan shall provide detailed component or subsystem cutover plans, and specifically delineate between systems that affect and do not affect ongoing operations

d. The City reserves the right to approve or suggest change(s) to the Migration/Cutover Plan as it relates to any or all system components

e. Contractor shall successfully complete all tests and training prior to the actual cutover of systems

f. Contractor shall provide the labor to program existing and/or new radios to operate on the legacy and new system

g. If a phased migration is proposed, the Contractor shall identify the number of iterations required and provide the labor to re-program existing and/or new radios to operate on the legacy and/or new system

h. Contractor shall provide the necessary labor to cutover from existing system(s) to the System

i. Once new system passes 30-day burn-in and is accepted by the City, the Contractor shall provide the necessary resources and labor to re-program existing and/or new radios to remove the legacy system

10. Coverage Acceptance Test Plan (CATP), complete with coverage overview, service area definitions and grid structures, talk-in and talk-out test procedures, City and Contractor responsibilities, and sample pass/fail sheet

11. Sample factory testing documentation for each piece of equipment

12. System installation, optimization, operation, and maintenance manuals for all equipment

13. Blank site installation, grounding remediation, and optimization documents to be completed during and after installation and provided with as-built documentation

14. Tower structural analysis, based on TIA-222 latest revision, showing results of passing or failed tower and/or foundation with existing and proposed antenna(s)

    a. Structural analysis for failed tower and/or foundation shall detail the required or recommended modifications for tower and/or foundation remediation

b. Sites without a completed structural analysis, tower mapping, and/or remediation pricing shall not be presented at Detailed Design Review

15. Geotechnical evaluation (study/report), approved and stamped by a California registered Professional Engineer (PE), for sites that require replacement or installation of new tower and/or foundation

16. Complete Detailed Design package for each site, consisting at a minimum the following content:

    a. Cover page with site name, site type (control, multicast, simulcast, etc.), simulcast cell name (if applicable), technology (Conventional, P25 Phase 1, P25 Phase 2, etc.), frequency band, number of channels, and other pertinent site data if applicable (region, site ID, etc.), Google Earth site photo, accurate site coordinates, elevation, County name, ownership (land, tower, shelter)

    b. Index page with sheet titles, drawing descriptions, drawing versions, and page numbers

    c. Block diagram(s) showing entire network and any subsystem-specific diagram

    d. Mobile and Portable Talk-in and Talk-out coverage maps

    e. Site plan showing existing and/or proposed site compound, tower(s), and shelter(s), all to scale and orientation

    f. Tower drawings (to scale and different elevations as needed) including tower type and height, number of legs, existing and proposed antenna and coaxial cable loading information, antenna center line heights, and any other equipment mounted on the tower

    g. Transitional and final floor plan drawings, including room layouts with doorways, existing and proposed rack location(s), cable trays, RF entry port(s), power system(s), HVAC unit(s), generator room(s), all to scale with interior and exterior dimensions and measurements of rack(s) to room/shelter walls and/or other surrounding equipment

    h. Equipment rack/cabinet elevation diagrams for radio/backhaul rack(s), combiner rack(s), and any DC power rack(s), with dimensions and rack unit locations

    i. Equipment room/shelter power drawing(s) showing how new equipment connects to AC or DC power systems, as well as backup generator and UPS systems

j. Detailed electrical loading for AC and/or DC power systems (itemized by equipment types and quantities), as well as UPS and generator sizing and BTUs for HVAC for the entire site

k. Detailed antenna system drawings for proposed base station transmit and receive antennas, TTAs, and GPS antennas (if applicable), complete with quantities, model numbers, and configuration/interconnection

l. RF entry port drawing(s) showing existing and/or proposed entry ports, labels for existing and proposed transmission lines (color-coded by size), and quantity and types of lightning protection devices

m. Interior and exterior site grounding system drawings

n. Site-specific frequency and combiner plans

o. Network equipment interconnection drawings showing router and switch connections, with cables and port numbers labeled and color-coded

p. Site-specific IP addressing scheme, showing host names, host addresses, subnet mask, equipment use/description, and configuration-specific notes

q. Patching schedules and termination details for all cabling necessary for a complete record of the installation

r. Location of demarcation points for any items to be provided by the City

s. Site-specific bill of materials for all new equipment to be installed at the site

t. Site remediation summary (with pricing) based on results from Site Survey report, Grounding Assessment report, Geotechnical report, and Structural Analysis report

17. Factory Acceptance Test Plan (FATP) outlining a comprehensive series of tests that will demonstrate proof of performance and readiness for shipment

18. System Acceptance Test Plan (SATP) outlining a comprehensive series of tests that will demonstrate proof of performance after installation and optimization is complete

19. Fleet Mapping Plan, taking into consideration the existing channels, talkgroups, and/or interoperability resources

20. Any other items as required or requested by the City that may be critical to the Detailed Design package

D. The Final FATP and Final SATP shall be submitted no later than 15 business days before the testing starts and shall be approved no later than five business days before the testing starts.

E. Detailed Design Review (DDR) meeting(s) shall be conducted to allow the Contractor to present the System detailed design for review and approval.

F. All items required for Detail Design shall be submitted to the City 10 business days prior to the DDR meeting(s).

G. The DDR shall be considered the last step prior to ordering and/or manufacturing of equipment. Upon approval of the Detailed Design by the City, the Contractor may begin the ordering and manufacturing of system equipment. The City shall not be held liable for any equipment ordered or manufactured prior to approval of the detailed design.

5.7 Staging

A. Each individual assembly or equipment unit for the LMR and dispatch systems shall be staged and undergo factory testing prior to shipment.

B. Contractor shall submit standard factory test documentation, documenting the tests performed and indicating successful completion of testing to the City.

C. Factory/System staging:

1. Contractor shall perform complete system staging and testing at a location in the United States.
2. The intent of the staging tests is to demonstrate to the City that the System is ready for shipment and installation.
3. Contractor shall provide all necessary technical personnel, and test equipment to conduct staging tests.
4. Contractor shall plan and execute additional staging / factory tests if Contractor proposes a phased approach, cannot complete in one setting, and/or requires retesting due to number of failed tests.
5. All deviations, anomalies, and test failures shall be resolved at the Contractor’s expense.
6. Contractor shall use an approved FATP per the DDR process.
7. Contractor shall successfully perform all tests, and provide the City with dry run results, before the City witnesses the official FATP.

8. Contractor and the City shall jointly execute and date the FATP following completion of all tests.
9. All tests in the FATP shall be marked as either pass or fail.
10. Contractor shall document all failed components.
11. Contractor shall correct and retest all failed components.
12. Contractor shall replace at its own expense failed components that are not repairable.
13. The decision to retest any failed tests or the entire FATP shall be at the City's discretion.
14. Contractor shall provide the City with the fully executed and complete FATP document.
15. There shall be no conditional acceptance of the FATP.

D. Contractor shall place asset tags on Contractor supplied equipment. The City shall provide and ship the asset tags to the Contractor's factory or staging facility.

5.8 Shipping and Warehousing

A. Contractor shall ship and warehouse all equipment and materials. The City will not store equipment.

B. Contractor shall be responsible for transporting LMR and backhaul equipment to and from the Contractor's warehouse(s) and the City sites.

C. Contractor maintains all liability and risk for all equipment until it has been installed, tested, cutover, and accepted at the site.

5.9 Tower Installation

5.9.1 General

A. Contractor shall:

1. Furnish all materials, labor, equipment, and mounting hardware to provide a complete functional tower installation
2. Perform all operations required for the installation
3. Be responsible for all concrete work and excavation

B. All concrete work shall comply with manufacturer's recommendations, including temperature, slump and air content.

C. Two sets of fresh field concrete specimens shall be taken for each concrete pour.

1. One set of field-cured concrete specimens shall be tested for weight.
2. One set of specimens shall be tested for compressive strength with the tests to be taken at 7 days and at 28 days.
3. The results of these tests will be presented to the City.
4. The compressive strength test shall be the average of the two specimens from the same composite sample.

D. Tower documentation shall include construction, installation, and maintenance drawings.

E. All drawings shall be approved and stamped by a California registered Professional Engineer (PE).

5.9.2 Tower Erection

A. The foundation shall be allowed to cure for at least 7 calendar days before erecting the tower.

B. Manufacturer recommended bolts shall be used for all connections in accordance with the installation documentation.

C. Bolts should be of such lengths as to protrude beyond the nuts a minimum of ¼ inch and a maximum of ½ inch.

D. All bolts shall be equipped with self-locking nuts.

E. Field reaming of coated metal components will be acceptable only upon determining there is no structural damage to the tower.

F. Field remanufactured holes shall be hot stick galvanized as specified and completely filled by the use of a larger diameter bolt.

G. All bolts placed through slotted holes shall be equipped with flat washers.

H. Mud, dirt, and other foreign matter shall be removed from the tower sections before erection. Special attention shall be given to cleaning the contact surfaces at joints before they are bolted together.

I. When portions of the tower are ground assembled, such assembly shall be on rigid surfaces or blocking, which will provide support to prevent distortion of tower steel and damage to surface finish.

1. All bolts shall be installed in all connections of ground assembled portions of the tower.
2. Temporary bracing of tower members shall be used to avoid overstressing or distortion.

J. The structure shall be erected plumb.

K. The method of assembling and erecting shall be such that no member will be subjected to a load in excess of that for which it was designed.

L. Extreme care shall be taken to establish and maintain the true geometric shape of the portion of the tower assembled.

1. All connections shall lie flat where bolted together.
2. No gaps between butt flanges or connections are acceptable after the bolts are tensioned.

M. Slings or other equipment used for picking up members or portions of the tower shall be of such material or protected in such a way as to not damage the tower section, the finish, or distort or overstress the tower when lifts are made.

N. Portions of the tower shall be raised in such a manner that no dragging on the ground or against other hard surfaces occurs.

O. Damaged tower sections can be used if properly repaired.

1. If a damaged portion cannot be repaired to the satisfaction of the City, it shall be replaced.
2. For any galvanized surfaces, damaged for any reason, zinc-based solder repair shall be used.
    a. Solders in a rod form or a powder may be used.
    b. Surfaces shall be cleaned using a wire brush or a light grinding action.
    c. Surface preparation shall extend into the surrounding undamaged galvanized coating.
    d. The thickness of zinc solder repair shall be equivalent to the originally specified hot dip galvanizing process.
    e. Repairs shall be performed in accordance with the solder manufacturer’s instructions.

P. Only wrenches of proper size, which will not deform the nuts, nor damage the surface finish, are to be used.

Q. Standard ironworkers’ 12-inch spud or 12-inch socket wrenches shall be used.

R. Pipe extenders will not be permitted.

S. During construction of the tower where required, the obstruction lighting fixtures shall be installed and operated at each required level as each such level is exceeded in height during construction.

5.9.3 Grounding

A. The tower and all appurtenances shall be installed in accordance with the grounding standard (from Section 1.1.3.B) selected by the Contractor.

B. All equipment mounted on the tower shall be properly bonded/grounded to the tower.

C. All antenna systems shall be effectively grounded and provide surge protection to all equipment.

D. All antenna transmission lines shall be properly bonded/grounded to the tower.

1. At a minimum, transmission lines shall be bonded/grounded at the antenna base, at the base of the tower, and at the exterior ground bar located at the entry to the building.
2. Additionally, transmission lines shall be bonded/grounded to the tower or cable ladders at intervals recommended by the manufacturer.
3. Antenna transmission line ground conductors shall be bonded to the tower in compliance with standards.

E. The site installation should have less than 5 Ohms resistance between any connected point on the ground bus and earth ground.

F. Contractor shall test ground resistivity using the four-point method.

G. Contractor shall supply a ground test report that fully describes the testing method used.

5.10 System Installation

A. Installation shall consist of a complete tested system to include placement of associated cabling, appropriate system layout, and terminal connections. City personnel shall escort the Contractor to each site during installation.

B. Contractor shall comply with industry best practices for cable installation and management in equipment racks and/or cabinets and within equipment rooms and/or shelters, as outlined in the following standards:

1. ANSI/TIA-942: Telecommunications Infrastructure Standard for Data Centers
2. ANSI/BICSI N1-2019: Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure
3. NFPA 70: National Electrical Code® (NEC®), Article 392 Cable Trays

4. IPC/WHMA-A-620D: Requirements and Acceptance for Cable and Wire Harness Assemblies, 2020-January, Class 2: Dedicated Service, at a minimum
5. ISO/IEC 14763-2:2019: Information technology — Implementation and operation of customer premises cabling — Part 2: Planning and installation
6. UL 60950-1: Information Technology Equipment – Safety – Part 1: General Requirements
7. UL 62275: Cable Management Systems - Cable Ties for Electrical Installations
8. UL 2024: Cable Routing Assemblies and Communications Raceways

C. Contractor shall provide associated power supplies and any other hardware, adapters, and/ or connections to deliver a complete operable system to the City.

D. Contractor shall participate in a mandatory site survey with the City to confirm actual equipment location within each space prior to the start of the System installation.

E. During the site survey, the Contractor shall determine and document any exact locations that differ from the detailed design installation drawings.

F. All detailed design drawings and documents requiring changes shall be revised prior to installation.

G. Contractor shall coordinate with others, as appropriate, to confirm that any preparatory work that affects the installation of the base station equipment, such as tower work, coring, bracing, conduit, and electrical, is complete before final inspection.

H. Contractor shall provide and pay for all materials necessary for the execution and completion of all work.

I. Unless otherwise specified, all materials incorporated into the permanent work shall be new and shall meet the requirements of this RFP.

J. All materials furnished and work completed shall be subject to inspection by the City.

K. Contractor shall be responsible for preparing and submitting the necessary applications for site permissions/access to install system equipment at non-City-owned sites.

L. Contractor shall be responsible for any leases, space, and/or shelter at any site in the System (City-owned, County-owned, and/or non-City-owned sites) for temporary space needed during installation and cutover to the System.

M. Contractor is responsible at all space-limited sites (not just leased sites) for planning, coordinating, supplying temporary shelter or site-on-wheels, moving/installing of existing and new equipment, and decommissioning of old equipment.

N. Qualified, trained personnel experienced with this type of work, shall perform all installations.

1. The City shall preapprove all subcontractors.
2. The City shall preapprove any change in subcontractor or its staff.

O. Equipment installation will be compliant with all applicable standards for seismic bracing.

1. Equipment placement in racks or cabinets shall be such that heavier items are lower in the racks while lighter items are higher in the racks to minimize the effect of centrifugal forces and swaying during an earthquake.
2. Bracing of equipment is required during unattended periods of construction.

P. Contractor shall not use equipment supplied as spares for installation of the proposed system.

Q. Contractor shall supply all spare equipment in new condition.

R. Contractor shall clean all equipment and devices and repair all damaged finishes.

S. Contractor shall leave sites neat, and broom swept upon completion of work each day.

T. Contractor shall thoroughly clean all equipment shelter and building floors and remove all scuff marks and abrasions prior to acceptance.

U. Contractor shall remove all trash weekly.

V. Inspection:

1. Contractor shall provide a standardized site checklist for client review and approval.
2. Site manager(s) shall use the approved site checklist for every site inspection and acceptance

3. The City shall conduct an inspection of the installations upon substantial completion.
4. The City shall document any deficiencies on a single punch list and provide the punch list to the Contractor for resolution.
5. Final acceptance testing shall not commence until all punch list items are resolved.

W. Contractor shall provide the City with all programming cables required for the programming or configuring of any provided piece of equipment.

5.11 Acceptance Testing

A. The City requires that the System will include a phased implementation. Acceptance testing shall be planned and performed based on the Contractor-developed Implementation and Migration/Cutover Plans.

B. Acceptance testing shall be planned and performed at all sites in the System per the City-approved System Acceptance Test Plan (SATP).

5.11.1 General

A. Prior to testing, the Contractor shall:

1. Verify and document that all equipment, hardware, and software are upgraded to the latest factory revision. Multiple revision levels among same equipment types are not acceptable.
2. Provide two weeks written notice to the City that the System is ready.
3. Submit a Test Plan for review and approval by the City.

B. Contractor shall provide all test equipment and miscellaneous cables, adapters and parts required to perform all testing. All test equipment shall be calibrated prior to testing.

C. Contractor shall utilize quality instruments in proper condition for all tests. Calibration records for all instruments shall be available at the site during all testing.

D. Contractor shall perform all tests in the presence of the City or a City-approved representative.

E. Contractor shall submit all test schedules to the City for approval.

5.11.2 LMR Acceptance Testing

A. Prior to final acceptance testing, the Contractor shall verify and document upgrades of all equipment, hardware, and software to the latest factory revision.

   1. Multiple revision levels among similar equipment are not acceptable.

B. Contractor shall provide the City with 2-weeks written notice that the System is ready for final acceptance testing.

C. Contractor shall use the completed and approved System ATP (SATP) to test all System equipment at all sites in the design.

D. Contractor shall successfully perform all SATP tests before the City witnesses the official acceptance testing.

E. Contractor and the City representatives shall jointly execute and date the SATP following completion of all tests.

F. All tests in the SATP shall be marked as either pass or fail.

G. Contractor shall provide all necessary technical personnel and test equipment to conduct acceptance tests.

H. All deviations, anomalies, and test failures shall be resolved at the Contractor's expense.

I. Contractor shall document, correct, and retest all failed components.

J. Contractor shall replace at its own expense any failed component that is not repairable.

K. Retest of individual failed tests or the entire SATP shall be at the City's discretion.

L. Contractor shall provide the City with the fully executed and completed SATP document.

M. There shall be no conditional acceptance of the SATP.

5.11.3 Microwave Backhaul Testing

5.11.3.1 Antenna System Tests

A. Contractor shall conduct return loss (RL) testing on all Contractor-provided microwave antenna systems and new links. The antenna system includes the antenna, waveguide and connectors.

B. The measured return loss of the antenna system shall be 21 dB or greater over the specified frequency range of the antenna. For RL testing the Contractor shall:

1. Perform RL tests after the antenna system has been installed, and prior to antenna alignment
2. Include a copy of the RL trace in the Test Report
3. If the RL of the antenna system is < 21 dB, perform a distance to fault (DTF) measurement to identify fault area(s)
4. Make any repair or replacement required and repeat testing until a 21 dB RL is achieved over the specified frequency range of the antenna

5.11.3.2 Microwave Radio Path Tests

A. Contractor shall perform the following tests for each radio path.

1. Transmitter
    a. Measure and record the microwave radio transmit power at the center frequency of each radio at each modulation rate and verify it is within the expected tolerance.
    b. Measure and record the output frequency of each radio transmitter and verify it is within the specified limits.
    c. If either the transmit power or frequency are not within expected limits, investigate and correct the issue before beginning the tests described below.
2. Receive Signal Strength
    a. For each radio link, measure the RSL under no-fade conditions and verify that it is within 2 dB of the expected value. If the RSL is not within 2 dB of the expected value, investigate and correct the issue before beginning the remaining tests described below.
3. Thermal Fade Margin (to confirm that the calculated fade margin matches actual performance)
    a. Conduct this test after it has been verified that the expected RSL for normal link operation is present at both ends of the link.
    b. Fade the receiver using an external continuously variable vane attenuator (0 to 60 dB) in series with the receiver.
    c. Apply attenuation using the vane attenuator until the receiver reaches the 10-6 and 10-3 BER thresholds.
    d. The fade margin is equal to the amount of attenuation that was required to reduce the received signal level to the 10-6 and 10-3

thresholds. Record both values. The fade margin shall be no less than 2 dB lower than the calculated value.

e. Contractor shall remedy the source of degradation if the fade margin does not meet this requirement.

4. Far-End Transmit Fade Test:

a. Fade the far end transmitter using a continuously variable vane attenuator and record the fade margin at the 10-6 and 10-3 BER thresholds. Note the difference between these fade margins and those achieved during the Thermal Fade Margin Test.

b. Results for Thermal Fade and the Far-End Transmit Fade that differ by 3 dB or more may indicate possible interference or presence of dribbling errors emanating from the far end transmitter. If transmit dribbling errors are suspected, reduce the transmit power of the Power Amplifier (or bypass the PA) and repeat Far-End Fade Test. If the difference is 3 dB or more, remedy the source of the degradation and retest.

5.11.3.3 Packet Internet Payload Performance

A. Long-term Ethernet Test - after successfully completing the Radio Path Tests, perform an RFC 2544 test, with the radio link at nominal RSL.

1. Begin generating Ethernet traffic at 100 Mbps, increasing the data rate until the test set indicates dropped packets, then reduce data rate until no packets are dropped for 10 minutes.

2. Continue generating Ethernet traffic across the radio path for a minimum of 12 hours and show that there was no packet loss.

3. If there is packet loss, identify and resolve the issue, and then repeat the test until there is no packet loss.

5.12 Coverage Testing

A. Contractor shall submit a CATP during the preliminary design stage of the project that will validate the coverage requirements for the System.

B. Contractor shall submit a draft CATP during the initial design stage of the project. Upon City approval of all elements of the CATP, the Contractor shall submit the final CATP during the final design stage of the project.

C. The CATP shall be consistent with the procedures and guidelines outlined in the current version of TSB-88.

D. Coverage testing shall commence only after the radio systems are fully optimized, tested and aligned.

E. Significant changes to any system will require retesting of coverage at the City's discretion.

F. The CATP shall be conducted between May and September when trees are in full foliage

G. Contractor shall perform automated objective mobile drive testing (i.e., BER testing) of the System, and the results of that testing will be the determining factor for acceptance.

H. Test configurations shall represent typical operating configurations to the greatest extent possible, using portable and mobile radio equipment (including the proper microphones) that will be used with the System. In addition, the proper subscriber antenna location (e.g., roof-mounted, hip-level, etc.) should be simulated during the testing.

I. UHF System automated objective drive testing:

1. For groups of channels that have the same coverage footprint, with the same ERP licensed and configured, a single channel can be used for testing and can serve as pass/fail for the other channel(s) in that group.
2. Contractor shall test on-street BER with in a test configuration that accurately simulates all applicable coverage guarantees.
3. Contractor shall provide the City with all relevant parameters of the test configuration (e.g., line losses, simulated losses for body loss and/or height differential) prior to the start of coverage testing for approval by the City.
4. Contractor shall test at a statistically significant number of test locations throughout the required service areas. Methods for determining the minimum number of tiles are provided in TSB-88.
5. Contractor shall test both talk-out and talk-in BER.
6. Testing will be conducted in FDMA mode, and operating in the simulcast mode, as applicable.
7. All automated BER testing shall be conducted with City personnel present and participating in the testing process.

8. The BER test results shall be the determining factor for acceptance of the System coverage.
9. Inaccessible grids shall not count as a pass or a fail in the statistical analysis.

J. OPTIONAL VHF system non-automated subjective DAQ testing:

1. For groups of channels that have the same coverage footprint, with the same ERP licensed and configured, a single channel can be used for testing and can serve as pass/fail for the other channel(s) in that group.
2. Contractor shall perform on-street non-automated subjective DAQ coverage testing using portable radios typical of the System, in their proper configuration.
3. All subjective DAQ testing shall be conducted with City personnel present and participating in the testing process.
4. Contractor shall test at a statistically significant number of test locations throughout the required service areas. Methods for determining the minimum number of tiles are provided in TSB-88.
5. Contractor shall test both talk-out and talk-in DAQ.
6. Inaccessible grids shall not count as a pass or a fail in the statistical analysis.
7. The DAQ test results for the System shall be provided as informational.

K. Testing of individual sites for coverage acceptance will not be acceptable, unless explicitly agreed to by the City prior to acceptance testing.

L. For testing purposes, service areas shall be divided into 1/4-mile square test tiles [0.25-mile x 0.25-mile].

M. Contractor may subdivide test tiles if necessary.

N. Contractor shall not count inaccessible test tiles as either a pass or fail in the statistical analysis.

O. All accessible grids in each respective service area shall be tested and considered in the final pass/fail calculations, regardless of the level of coverage those grids are predicted to have in the coverage maps.

P. Should the coverage test fail, the Contractor shall correct the cause of the failure and **re-conduct the coverage test in its entirety.**

Q. Contractor shall measure talk-out and talk-in performance separately for each test tile (i.e., BER and DAQ shall be measured in both directions in each test tile),

and the overall system pass/fail percentages shall be calculated for each direction distinctly.

R. Contractor shall document talk-out and talk-in performance of all coverage tests, as applicable, and provide the results to the City for review.

S. All raw data collected from all coverage tests shall be provided to the City in formats that are readable by the City.

T. Contractor shall perform non-automated subjective DAQ testing inside the following critical buildings:

1. Lompoc Valley Medical Center – Twenty test locations, uniformly distributed on the ground floor.
2. Lompoc City Landfill – Five test locations, one in each corner and one in center.

5.13 Training

5.13.1 Training Programs

Contractor shall develop and conduct training programs to allow the City personnel to become knowledgeable with the System, subsystems, and individual equipment.

A. Contractor shall provide:

1. Subscriber device training
2. Console operation training
3. Training shall cover all features, operation, and special care associated with the equipment supplied.

B. Operational training shall include the following categories:

1. APCO P25 Fundamentals
2. P25 Portable Unit Operation
3. P25 Mobile Unit Operation
4. P25 IP Console Operation

C. Contractor shall provide technical/system management training, including:

1. Complete and comprehensive technical training as applicable to the System design
2. This training shall include:
    a. System theory

b. Troubleshooting

c. Repair

d. Servicing techniques

3. Technical training shall include the following categories:

a. P25 Systems Operations

b. P25 Control Site Design

c. P25 Repeater Site Design

d. P25 Digital Simulcast Design and Interference Analysis

e. P25 System Troubleshooting

f. P25 Base Station Programming and Maintenance

g. P25 Subscriber Programming, and Maintenance

h. Fleetmapping and Template Development

i. Coverage Mapping Tools, Propagation Analysis & Prediction Modeling

j. Dispatch Console maintenance, configuration, and troubleshooting

k. Microwave system maintenance, configuration, and troubleshooting

l. NMS maintenance, configuration, troubleshooting and report generation

m. Router, switch, and firewall maintenance, configuration, and troubleshooting

D. Contractor shall provide system management training for technical staff responsible for managing the P25 and backhaul system.

E. System management training shall include, but is not limited to:

1. Planning and setting up the System and network

2. Building and implementing system and network profiles and configurations

3. Performing database management functions

4. Monitoring and managing the System's performance

5. Writing and printing system reports.

F. Contractor shall:

1. Conduct all training at a location where duplication of system operation will not impact daily operations

2. Coordinate with the City regarding number of attendees, schedule, and training location
3. Schedule classes as close to system cutover as possible
4. Train the City employees or designated individuals

G. For console and subscriber operator training, the Contractor shall provide "train-the-trainer" courses to selected City personnel.

5.13.2 Training Materials

A. Contractor shall provide all instructional material, for all technical and operational training classes for the exact model and series of equipment delivered, including:

1. Printed manuals
2. Audio, video, interactive self-paced personal computer programs
3. Complete equipment operating instructions

B. All instructional material shall be subject to the approval of the City and shall become property of the City.

C. Training materials shall be professionally produced and provided in binders.

1. Loose leaf materials are not permitted
2. Paper shall be 8 ½ x 11" whenever possible
3. If larger paper is utilized, it shall be professionally incorporated into the document
4. Binders shall be color coded where it will provide an organizational benefit
5. Illustrations and photographs, where provided, shall be specific to the City installation
6. Color photos shall be provided where detail or clarity is supported by use of color
7. Black and white photocopying of color materials is unacceptable

D. Contractor shall provide fully editable (softcopy) versions of all training materials so that the City trainers can update the course materials.

5.14 System Cutover

5.14.1 Cutover Plan

A. Contractor shall develop a Cutover Plan for review and approval by the City. The City reserves the right to approve and change the cutover plan as it relates to

any or all system components. The Cutover Plan shall be logical and shall consider every facet of the existing and new networks. Key objectives of the Cutover Plan are:

1. Ensure that new systems are brought online with minimum interruption to all existing systems and communications.
2. Contractor shall be responsible for planning, coordinating, supplying, and implementation of all equipment, subsystems, and the overall System migration and cutover.
3. Contractor shall:
    a. Be responsible for any costs associated with their proposed cutover plan.
    b. Program the users' existing and/or new radios
    c. Identify the cutover of individual circuits
    d. Identify temporary alternate routing of critical circuits
    e. Include fallback, recovery, and contingency plans to mitigate the risk of circuit failure during cutover
    f. Maintain reliable and stable communications
    g. Ensure the timely deployment of a complete and functional network
    h. Identify physical and technical constraints that shall be considered for successful implementation planning such as site ownership, site access, shelter space, tower loading and availability and electrical load limitations
    i. Ensure successful integration with all legacy systems, including a smooth transition from existing operations
4. Clearly defined roles and responsibilities between the Contractor and the City**.**

B. The Cutover Plan shall demonstrate that it meets the following requirements:

1. Supports the operational requirements of each participating department
2. Ensures users and technical staff are prepared for the migration to the new network
3. Mitigates risk
4. Does not exceed maximum outage times
5. Considers site access issues, such as sites that are inaccessible during winter months

C. During detailed design, the Contractor shall deliver a draft Cutover Plan describing how the existing radio systems will be migrated to the System.

D. The Cutover Plan shall:

1. Include the schedule and procedures associated with the transition of each operational user group
2. Specifically address how the existing users will begin using the System with minimal operational impact
3. Provide detailed component or subsystem cutover plans, and specifically delineate between systems that affect and do not affect ongoing operations

E. The City reserves the right to approve and change the Cutover Plan as it relates to any or all system components.

5.14.2 Cutover Execution

A. After successful completion of all tests and training, the Contractor shall execute the System cutover according to the approved Cutover Plan.

B. Any modifications to the plan shall be proposed to and approved by the City at least ten business days prior to execution.

C. Contractor shall provide 5 business days advance notice for required outages of the existing system during the cutover. All planned outages require approval of the City.

D. Contractor shall provide the necessary labor to cutover from existing systems to the System.

5.15 30-Day Operational Verification Period

A. Contractor shall plan and execute a 30-calendar-day operational burn-in period for the System.

B. The conditions of the test shall be determined during Final Design with plans including loading the System as fully as approved by the City.

C. Technical staff from the City shall monitor the burn-in period.

D. Contractor shall demonstrate the integrated operation, reliability, long-term stability, and maintainability of the System during this period.

E. System shall be fully loaded with all City users fully migrated.

F. A Critical failure of the System during this test will cause the burn-in period to reset and restart from the beginning after completion of the repair.

1. A Critical Failure is defined as follows:

a. Any failure which causes a loss of 15% or more in capacity or coverage in any cell

b. Any failure which causes a loss of the primary system control

c. Any failure which causes a loss of simulcast capability

d. The concurrent failure of two or more repeaters

e. Concurrent failure of two or more switches and/or routers

f. Any system failure that causes the loss of two or more console positions

g. Any failure that renders the logging recorder inoperable or caused the irretrievable loss of recorded audio

h. Failure of the receiver voting system

i. Two or more Major Failures

G. A Major Failure will cause the burn-in period to temporarily hold until the issue has been fully resolved to the City's satisfaction. After resolution of the failure, and with City approval, the burn-in period will continue.

1. A Major Failure is defined as follows:

a. Two or more repetitive Minor Failures of a System feature (supported by hardware and/or software)

b. Two or more repetitive Minor Failures of the same piece of System component (hardware only) with or without the same root cause

c. Two or more repetitive Minor Failures with the same root cause

H. A Minor Failure will cause the burn-in period to temporarily hold until the issue has been fully resolved to the City satisfaction. After resolution of the failure, and with City approval, the burn-in period will continue.

1. A Minor Failure is defined as a failure of any piece of hardware and/or software with the determination of cause

I. Two or more similar Minor Failures without the determination of cause will temporarily hold the burn-in test until a cause is found and corrected, or the City is satisfied there is little likelihood of a systemic recurring issue.

5.16 Decommissioning, Removal, and Disposal of Legacy Equipment

A. Contractor shall remove existing/legacy equipment (e.g., repeaters, voters, microwave radios, consoles, control stations, mobiles, cables, and antenna systems) not being reused in the System or identified for future use by City.

   1. Removal of electronic equipment ("e-waste") shall comply with Federal Resource Conservation and Recovery Act (RCRA) and/or State (Health and Safety Code) hazardous waste laws.

   2. Equipment purchased by the Contractor as Trade-In shall be removed and handled according to the terms of any applicable Trade-in agreement.

B. Contractor shall maintain a detailed inventory of all equipment removed, listing the following at a minimum:

   1. The owning agency

   2. Model numbers

   3. Serial numbers

   4. Asset numbers

   5. Location removed from

   6. Location within the warehouse

   7. Trade-in or disposition value

C. Contractor, at its sole expense, shall warehouse, as necessary, removed equipment prior to disposal.

D. Contractor, at its sole expense, shall transport all removed equipment to the City-specified disposal location.

5.17 As-Built Documentation

A. At the completion of System implementation, the Contractor shall provide complete as-built documentation as outlined below:

   1. Equipment provided

   2. Site plan drawings

   3. Tower and antenna drawings

   4. Shelter floor plans

   5. Cabling and terminations

   6. Block and rack diagrams

   7. Fleet mapping and programming

8. Setup, configuration, and alignment information, to include commissioning, provisioning, test and turn-up
9. Successfully completed of all Acceptance Test Plans

B. Site-related submittals and as-built documentation including but not limited to structural analysis, geotechnical report, grounding audit, survey report, and site photos for all sites visits shall be consistent across all sites.

C. Contractor shall provide final documentation in printed form:

1. Six bound, hard copy, printed sets
    a. Hand modified drawings are not acceptable.
    b. Hard copies of all drawings shall be 11" x 17".

D. Contractor shall provide final documentation on DVD in electronic form:

1. All drawings provided in MS-Visio native format
2. All other documentation provided in MS-Word or MS-Excel native format
3. A copy of all drawings and documentation in Adobe Portable Document Format (PDF)

5.18 System Acceptance

A. The City shall deem the System ready for final acceptance following successful completion and approval of the following:

1. Final Detailed Design
2. Factory Acceptance Test
3. All contracted installation completed
4. Final inspection and punch list resolution
5. Coverage Acceptance Test
6. System Acceptance Test
7. System migration and cutover
8. Training completed
9. Successful completion of 30-Day Burn-in
10. As-built documentation

B. No conditional acceptances will be granted.

6. Warranty, Maintenance, and Support

A. The System will be based on a hybrid system support model, where the Contractor has primary responsibility for system maintenance and repair during the warranty period, with assistance provided by the City for access and onsite assistance. Upon expiration of the warranty, the City's radio shop has primary responsibility for system maintenance and repair, with assistance provided by the Contractor as needed.

B. Contractor shall provide an initial 1-year warranty, including Network Operations Center (NOC) monitoring, cybersecurity, and remote and on-site support for all hardware, software and firmware for all Contractor-supplied system components (including third-party equipment).

C. Should the Contractor be a system integrator, negotiated pricing and discounts for all equipment (including third-party) shall remain throughout the term of the contract.

6.1 Warranty

A. All equipment provided shall be new and covered by a full manufacturer's warranty for one year, commencing with System acceptance by the City.

B. Any new equipment added after System acceptance shall include a manufacturer's warranty for a minimum of one year. The warranty shall commence upon acceptance of the equipment by the City. Contractor shall offer the OPTION to purchase post-warranty service(s) listed in Section 6.4 for the new equipment.

C. System performance, installation, and all hardware, parts, software, and materials (including third-party equipment) shall be covered during the warranty period.

   1. During the warranty period, the Contractor shall provide monitoring, on-site repair, 24x7, security monitoring, software patches, and software upgrades.

   2. Warranty coverage shall include all related return and delivery fees.

D. Contractor shall provide a single toll-free telephone number staffed and available 24 hours a day, 7 days a week, 365 days a year, for service requests and warranty claims.

E. Following expiration of warranty, the City's radio shop shall be the first line of maintenance with the Contractor providing support as required.

1. City's personnel will escort the Contractor to all sites requiring Contractor level on-site support.

F. During the warranty period, service and repair shall be performed 24 hours a day, 7 days a week, 365 days a year.

1. There shall be no additional charges for work outside of normal Contractor business hours.

G. The City shall have the right to perform any maintenance and/or repairs required during the warranty period without voiding or affecting the Contractor's warranty.

H. If Contractor level support is required, the following repair response time and repair-completed time criteria shall be in effect:

1. Contractor shall contact the City within 30 minutes of telephone notification for a Critical Service issue.

2. The City defines Critical Service issue as any one or more of the following events that results in a loss of voice traffic on the System:

a. Any failure which causes a loss of 15% or more in capacity or coverage (system-wide or in any single simulcast cell)

b. Any failure which causes a loss of simulcast capability

c. Any failure which causes a loss of system control (distributed or primary/secondary architecture)

d. The failure of one or more repeaters

e. Concurrent failure of one or more switches and/or routers

f. Failure of the receiver voting system

g. Any system failure that causes the loss of one or more console positions

h. If applicable, any failure that renders the Contractor-provided logging recorder inoperable or causes a loss of recorded audio

3. Contractor's qualified service representative and the City's representative shall attempt to resolve the Critical Service issue over the phone or via remote network management.

4. If the Contractor's qualified service representative and the City's representative cannot resolve the issue remotely or over the phone, then the City shall make the determination regarding the criticality of the service issue.

a. If determined to be critical the Contractor shall dispatch a qualified service representative to the site experiencing the service issue.

5. Contractor's qualified service representative shall be physically present at the site that requires service within 4 hours of City's decision to escalate the call to on-site service.

6. On-site Contractor's service representative shall make every effort to resolve the Critical Service issue within 12 hours from the time the critical service issue was reported.

I. Contractor shall repair all equipment, hardware, and software throughout the implementation, cutover and warranty periods.

J. The following procedures shall be followed during the warranty period:

1. Contractor shall provide the City with written documentation indicating:

a. The cause of the service outage

b. The resolution

c. All post-repair testing procedures to ensure proper operation

2. In the event the Contractor uses City-owned spares to complete a repair, the documentation shall include the model and serial number of both the defective unit and the spare.

3. Contractor shall validate the spare equipment is functioning properly with latest firmware and software. Contractor shall provide a replacement for the spare equipment. Contractor shall install the replacement equipment and return the original spare equipment to the spares inventory.

4. For all hardware equipment needing factory or depot repairs, the Contractor shall maintain a comprehensive tracking system to track units to and from the factory/depot.

K. Replacement parts shall be new or original repaired parts only.

L. Fixed equipment mail-in board repair shall be completed within seven calendar days of receipt.

M. Equipment shall be returned to the City via second-day shipping, with tracking number provided to the City.

N. Serialized units sent in for depot repair shall not be exchanged unless specifically authorized by the City.

O. The original unit shall be repaired and returned unless specifically authorized by the City.

P. Contractor shall warrant all software and firmware for all supplied equipment (including third-party equipment).

Q. During the installation, warranty, and extended warranty periods, the Contractor shall provide commercially available upgrades of all software and firmware originally sold to the City.

R. The frequency and timing of installation of upgrades during this period shall be at the sole discretion of the City based on availability by the Contractor.

S. Contractor shall provide all back-up media and revised software manuals to the City at the time of any software revisions.

T. Contractor shall update all devices to the same and latest release level prior to the conclusion of the warranty period.

U. Recurring Failures and Manufacturer Defects:

1. Any fixed equipment or fixed equipment module that fails twice during the acceptance test or twice during the first 12 months after System Acceptance shall be indicative of a recurring or systemic failure or defect that warrants further investigation by the Contractor and City.

2. If the defect is deemed by the City to be systemic after the investigation is completed, the Contractor shall then be responsible for replacing all equipment and/or equipment modules related to the recurring or systemic failure, not only the specific equipment affected.

V. Contractor shall correct latent design defects or recurring problems relating to software, firmware, hardware, or overall system design, during the warranty period.

W. During the warranty period, the Contractor shall correct all system malfunctions due to software.

X. If, during the first 5 years after System Acceptance, 25% of any type of Contractor supplied equipment or material fails, the Contractor shall replace this equipment or material throughout the System at no cost to the City.

6.2 Parts Availability

A. Contractor shall certify that replacement parts for all delivered equipment shall be available for a period of at least 10 years after the last date of production.

B. In the event the Contractor plans to discontinue manufacture of any product-line or stocking any part required for maintenance in the System, the Contractor shall send written notice to the City 24 months prior to the date of discontinuance to allow for last-time buys and spares replenishment.

C. No part may be discontinued within five years of system acceptance.

6.3 Spare and Test Equipment

A. Contractor shall include recommended initial spare parts and test equipment to be procured as part of the initial contract. The City is required to maintain the necessary spares on hand to repair and provide timely restoration of the System.

B. The initial spare parts and equipment shall include, but is not limited to, the following:

1. All Contractor identified Field Replaceable Units (FRUs)
2. All infrastructure components having no FRUs, but that can cause a critical failure (e.g., antenna systems, other non-modular components), including all third-party equipment items
3. Power supplies
4. Required and/or recommended test, measurement, calibration equipment, and repair kits
5. Recommended diagnostic equipment to support the City maintenance activities

C. Initial spares for less critical items shall also be enumerated.

D. The spare parts and equipment shall include items that will rapidly and completely restore all critical System functionality with the least amount of effort (e.g., board replacement instead of troubleshooting to component level when a critical unit fails).

E. Contractor shall determine the types and quantities of spares based on their proposed system size and design.

F. Contractor shall define the primary equipment category each spare kit supports (e.g., transceiver board for a base radio or interface board for a router).

6.4 Lifecycle Support

A. System(s) shall not be accepted with components or equipment at the end of their respective lifecycles or within five years of their respective lifecycle.

B. Contractor shall provide a roadmap for end-of-life dates on existing and/or proposed products.

C. A product for which development and/or distribution will be discontinued within the next 5 years shall be considered "end of lifecycle" products.

D. Contractor shall provide discounted software support and upgrades for the System.

E. Contractor shall provide spare parts and equipment at a discounted rate for the life of the contract.

F. Contractor shall provide technical support at a discounted rate for the life of the contract.

G. Contractor shall provide engineering services at a discounted rate for the life of the contract.

H. OPTIONAL - Contractor shall provide the technical services needed to maintain and manage the System, after the warranty has expired. Contractor shall offer the following post-warranty service(s) for all supplied equipment:

1. Remote technical support
2. Software support and upgrades
3. Cybersecurity support
4. Hardware refresh
5. Onsite support and repair
6. NOC monitoring

I. OPTIONAL - Contractor shall offer these post-warranty services in annual increments for a 10-year period following warranty expiration.

J. OPTIONAL - Contractor shall offer post-warranty services for any new equipment and/or sites added to the System.

Appendix A – Coverage Boundary Files

See *Appendix A - Boundary Files.zip* provided as separate electronic file.

Appendix B – Dark Fiber Availability

See *Appendix B - Dark Fiber Availability.xlsx* provided as separate electronic file.

Appendix C – Subscriber Unit Information

See *Appendix C - Subscriber Unit Information.xlsx* provided as separate electronic file.