

# Lakeside Fire Protection District



## Request for Proposals

### Public Safety Voice Radio Communications System Functional Specifications

Prepared by



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## Table of Contents

1.	Functional Specifications .....	5
1.1	Overview.....	5
1.2	Standards and Guidelines.....	6
1.3	Coverage Requirements .....	8
1.3.1	General Requirements.....	8
1.3.2	Central Zone Requirements.....	8
1.3.3	Coverage Analysis.....	9
1.3.4	Coverage Maps .....	10
1.4	LMR Site Equipment.....	12
1.4.1	General Requirements.....	12
1.4.2	Conventional Repeaters .....	12
1.4.3	Antenna Systems.....	13
1.5	Backhaul Network Requirements.....	14
1.5.1	General Backhaul Requirements .....	14
1.5.2	General Microwave Requirements.....	15
1.5.3	System Performance Requirements .....	17
1.5.4	Microwave Backhaul Equipment.....	18
1.6	Heartland Communications Facility.....	23
1.7	Optional Network Management System.....	23
2.	Site Improvements .....	24
2.1	General Requirements.....	24
2.2	Equipment Enclosures .....	26
2.2.1	Equipment Racks.....	26
2.2.2	Outdoor Cabinets.....	26
2.3	Site Generator .....	27
2.3.1	General .....	27
2.3.2	Power and Electric Requirements.....	27
2.3.3	Enclosure.....	27
2.3.4	Muffler Type.....	27





2.3.5	Control Panel .....	28
2.3.6	Miscellaneous .....	29
2.3.7	Automatic Transfer Switch (ATS).....	29
2.4	Tower Structure .....	29
2.4.1	General .....	29
2.4.2	Design Criteria .....	30
2.4.3	Waveguide Support .....	30
2.4.4	Waveguide Bridge .....	31
2.4.5	Climbing Equipment.....	32
2.5	Power Systems .....	32
2.5.1	DC Power Requirements .....	32
2.5.2	Uninterruptible Power Supply Requirements .....	36
3.	System Implementation, Test and Acceptance .....	39
3.1	Project Management.....	39
3.1.1	Project Staffing .....	39
3.1.2	Scheduling .....	40
3.1.3	Project Meetings .....	41
3.1.4	QA/QC Plan .....	42
3.1.5	Project Punch List.....	43
3.1.6	Background Checks.....	44
3.2	Site Surveys.....	45
3.3	Microwave Path Design .....	48
3.4	Detailed Design .....	49
3.5	Detailed Design Review .....	52
3.6	Frequency Coordination and Licensing.....	52
3.6.1	Intermodulation Interference .....	53
3.7	Staging.....	54
3.8	Shipping and Warehousing.....	55
3.9	System Installation.....	55
3.9.1	General Requirements.....	55
3.9.2	Antenna and Feedline Installation.....	56





3.9.3	Equipment Racks and Cables.....	57
3.9.4	Work Sites .....	58
3.9.5	Inspection .....	58
3.10	Coverage Testing .....	58
3.11	Acceptance Tests .....	61
3.11.1	General Requirements.....	61
3.11.2	LMR Acceptance Testing.....	62
3.11.3	Microwave Backhaul Acceptance Testing.....	63
3.12	Training.....	63
3.12.1	Training Programs .....	63
3.12.2	Training Materials .....	65
3.13	System Cutover .....	66
3.13.1	Cutover Plan .....	66
3.13.2	Cutover Execution.....	68
3.14	30-Day Operational Verification Period.....	68
3.15	Decommissioning, Removal, and Disposal of Legacy Equipment .....	69
3.16	As-Built Documentation .....	70
3.17	System Acceptance .....	71
4.	Warranty, Maintenance, and Support .....	73
4.1	Warranty .....	73
4.2	Parts Availability .....	76
4.3	Spare Equipment .....	77
4.4	Lifecycle Support .....	78
4.5	Post-Warranty Support .....	78
Appendix A –	Shape Files for Coverage Modeling.....	79
Appendix B –	Sun Wireless Study.....	80
Appendix C –	VHF Gap Analysis.....	81





## 1. Functional Specifications

These functional specifications describe the general, functional, and operational requirements of the desired system and the requirements for system architecture, performance, and support, including system implementation, testing and acceptance.

The term “District” in these specifications refers to the Lakeside Fire Protection District. The term “Contractor” in these specifications refers to the awarded contractor and all sub-contractor(s) hired by the Contractor. Therefore, any requirement that applies to the Contractor applies to the sub-contractor(s) as well. The Contractor, including all sub-contractor(s), must have a current Contractor’s License for the State(s) in which their crews will be performing the work.

### 1.1 Overview

- A. The District is seeking a Contractor to upgrade and expand their very high frequency (VHF) land mobile radio (LMR) system to support mission critical communications in the San Diego County Central Zone Area.
- B. The LMR system upgrade/expansion shall provide basic, two-way wireless communications capabilities to all radio users and shall include:
  - 1. New VHF analog conventional repeaters for enhanced radio coverage in the Central Zone.
  - 2. New licensed microwave links to connect existing and new VHF sites to the existing San Diego County Regional Communications System (RCS) backhaul network.
- C. The VHF conventional repeaters shall be installed at the following sites in the Central Zone Area used by the District:
  - 1. XSD CMD 9 - Cowles Mtn, Muth Valley, Oak Creek
  - 2. XSD CMD 15 - Muth Valley, Oak Creek
- D. Appendix B shows how the Central Zone channels are currently being used and how they will be used with the upgraded system.
- E. The LMR system shall provide mobile and on-street portable radio coverage throughout the Central Zone as specified in Section 1.3 of this document.





- F. The Contractor shall perform all installation, testing and cutover work in a way that allows the District to maintain communications on the existing radio systems to support wildland fire and all-hazard incident response.
- G. Although operating in analog mode, the LMR system shall comply with applicable TIA-102 Project 25 (P25) standards as published at the time of proposal.
- H. The LMR system shall be capable of supporting P25 Phase 1 Conventional mode using Frequency Division Multiple Access (FDMA) 12.5kHz channels.
- I. The LMR system shall be upgradeable to P25 Phase 1 and P25 Phase 2 Trunking operation. The Contractor shall describe hardware and/or software upgrades needed for operating in each mode.
- J. If needed, the LMR system shall include simulcast and voting equipment to meet the coverage and capacity needs.
- K. The LMR system shall be designed to industry standards, in areas such as rack and equipment wiring, grounding systems, and earthquake bracing.

## **1.2 Standards and Guidelines**

- A. The system 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. National Electrical Code (NEC) (NFPA-70)
  - 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. The system shall comply with industry best practices for system installation, grounding, bonding, and transient voltage surge suppression (TVSS).
- C. 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-D Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
  2. Harris Site Grounding and Lightning Protection Guidelines (AE/LZT - 123 4618/1 - 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 R56 - Standards and Guidelines for Communication Sites (latest revision)
- D. In addition to meeting the minimum requirements, the system shall comply with all recommended and/or optional specifications included in the selected standard(s).
- E. Other vendor-specific and/or industry published standard(s) recommended by the Contractor shall be submitted to the District for review and approval.
- F. If the requirements of this RFP differ with those of the governing codes and regulations, then the more stringent of the two shall apply.
- G. 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 it to the satisfaction of the District.
- H. If the Contractor cannot meet any of the standards or guidelines, the Contractor shall list all deviations in their proposal, for approval by the District.





### 1.3 Coverage Requirements

#### 1.3.1 General Requirements

- A. Delivered Audio Quality (DAQ) as defined in this document applies to both talk-in (subscriber units to repeater) and talk-out (repeater to subscriber units) 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. Coverage design, implementation, and testing for the system shall adhere to TIA Telecommunications Systems Bulletin (TSB)-88: Wireless Communications Systems Performance in Noise and Interference-Limited Situations, current version.
- C. The Contractor shall complete coverage testing with witnesses from the District, utilizing non-automated subjective DAQ testing for each XSD CMD channel.

#### 1.3.2 Central Zone Requirements

- A. The Contractor shall reference information in the following appendices for existing and future site locations, antenna details, equipment inventory, and coverage gaps:
  - 1. Appendix B – SunWireless Public Safety Radio and Microwave System Backhaul Study for Heartland Communications\_012323 (1).pdf
  - 2. Appendix C – VHF GAP Analysis San Diego MAIN\_A. (1).pdf
- B. The VHF radio system upgrade shall serve the geographical boundaries of the Central Zone. Appendix A, *Shape Files for Coverage Modeling*, has “shape”







(.SHP) files showing the coverage area boundaries that can be imported into a coverage modeling program.

- C. The Contractor shall perform composite mobile and on-street portable coverage analyses (talk-out and talk-in) for each channel in the Central Zone using the sites in Appendix B to show what areas can be covered.
- D. The Contractor shall specify the guaranteed talk-in and talk-out coverage that will be provided for each channel for mobile radios and on-street portable radios worn at hip level in a swivel case, with 95% reliability and a minimum DAQ of 3.4 within the Contractor's guaranteed coverage area boundary. The guaranteed coverage shall be the composite of all repeaters on a channel.
  - 1. For existing repeaters, the radio output power, and Effective Radiated Power (ERP) levels and antenna height and gain shall be the maximum as permitted by FCC rules and regulations and the District's FCC licenses.
  - 2. For new sites, the Contractor shall assume 100 watts ERP.
- E. After system installation, the Contractor shall be required to perform coverage testing to confirm specified coverage. Refer to Section 3.10, *Coverage Testing*.

### **1.3.3 Coverage Analysis**

- A. Coverage analyses shall adhere to the following specifications for determining the proposed system's ability to meet individual channel coverage requirements. All coverage analyses and maps shall be developed using the following specifications:
  - 1. The target device, usage and location are:
    - a. Outbound (talk-out) and inbound (talk-in) to/from mobile radios mounted in vehicle with a roof-top unity-gain antenna, with 50 watts maximum transmit power
    - b. Outbound (talk-out) and inbound (talk-in) to/from portable radios worn at hip level with proposed antenna, swivel case and speaker mic, with 5 watts maximum transmit power
  - 2. Basic coverage design for mobile radios shall accommodate vehicles at speeds up to 75 mph
  - 3. Required reliability within the guaranteed coverage area for each XSD CMD channel is 95%





4. Body loss factors for portable radio performance shall comply with the current version of TSB.88-1 Table D 4.
5. Any antenna derating factors for mobile radio performance shall comply with the current version of TSB.88-1 Table D 3.

#### **1.3.4 Coverage Maps**

- A. The Contractor shall provide a detailed description of the propagation models used and the assumptions made in preparation of the coverage maps.
- B. The Contractor shall provide talk-out and talk-in maps for each XSD CMD channel showing the composite coverage of all repeaters on the channel for mobile and on-street portables.
- C. The Contractor shall provide talk-out and talk-in maps showing the coverage for all individual repeaters for all channels for mobile and on-street portables.
- D. All coverage maps shall be clearly labeled and show system gain/loss factors for each of the following:
  1. Mobile radios mounted in vehicle using roof-top unity gain antenna
  2. Portable radios outdoors (on-street):
    - a. Talk-out to a portable radio on hip with swivel case and remote speaker/microphone
    - b. Talk-in from a portable radio on hip with swivel case and speaker/mic
- E. All maps shall clearly delineate the difference between areas predicted to be equal to or greater than DAQ 3.4 equivalent coverage and areas where coverage is less than DAQ 3.4
- F. Coverage maps shall be provided in the following formats:
  1. 8.5"x11" (minimum) full color hardcopy format
  2. In PDF file format with sufficient resolution to discern roadways and similar detail.
  3. In a computer file format that may be imported into Google Earth Pro (e.g., KML, KMZ).





- G. All maps shall include a background layer suitable for the District's reference (e.g., topographic map, roads, and rivers).
- H. Link budgets shall be provided, clearly defining the following minimum information, relating to each map and each site:
  - 1. Propagation model
  - 2. Design target
  - 3. Contractor-proposed ATP target (if different than design target)
  - 4. Faded performance criteria
  - 5. Inferred noise floor
  - 6. Repeater transmit power output
  - 7. Antenna gain (transmit and receive)
  - 8. Antenna down tilt (if applicable)
  - 9. Antenna azimuth
  - 10. Antenna height
  - 11. Transmit site effective radiated power (ERP)
  - 12. Receiver sensitivity
  - 13. Tower top amplifier and/or receive multicoupler gain, presented as both the gain setting on the unit and the “net” system gain
  - 14. Total antenna system gains, or losses
  - 15. Calculations utilized to determine antenna system gains, or losses
  - 16. Mobile and portable antenna height for talk-out and talk-in
  - 17. Mobile and portable transmit output power
  - 18. Loss factors used for portable radios (i.e. body loss)
- I. The Contractor shall use 30-meter elevation and land use/land clutter data, at a minimum, for coverage simulations.





## **1.4 LMR Site Equipment**

### **1.4.1 General Requirements**

- A. The site equipment, or RF infrastructure, consists of analog conventional repeaters, antenna systems and network switches.
- B. For sites that will have multiple XSD CMD channels (new or existing), the Contractor shall supply new 12-port Ethernet switches.
- C. All Contractor supplied equipment shall have monitor/alarm interfaces to provide status to a Network Management System via Ethernet/IP-based connection.
- D. All Contractor supplied equipment shall be equipped for 120 VAC power.

### **1.4.2 Conventional Repeaters**

- A. Conventional repeaters shall:
  - 1. Operate in the VHF frequency band (136 – 174 MHz) in conventional analog mode but shall be software upgradeable (without any hardware changes) to Project 25 Phase 1, conventional digital operation.
  - 2. Be solid state and function and must operate in the temperature range of -20°F to 140°F without degradation.
  - 3. Be provided with mounting configurations for standard relay rack or optional lockable cabinets.
  - 4. Consist of modular components or field replaceable units allowing for in the field repairs whenever possible.
  - 5. Comply with appropriate Part 90 and Part 15 of the FCC Rules and Regulations.
  - 6. Be FCC type accepted for the appropriate frequency band and type of service.
  - 7. Comply with appropriate TIA 102 and similar standards.





### **1.4.3 Antenna Systems**

- A. The repeater systems shall include all new antenna system equipment necessary for a complete design, including but not limited to:
  - 1. Antennas
    - a. Transmit and/or receive, as applicable
    - b. Omnidirectional or directional, as applicable
  - 2. Transmission line
    - a. Transmission line type shall be appropriate given the radio band and required length, to provide the required coverage
    - b. Transmission line length shall be appropriate per proposed antenna height(s) and VHF equipment rack placement
  - 3. RF filtering
    - a. VHF duplexer at single-channel sites
    - b. VHF transmit combiners at multi-channel sites
    - c. VHF receive multi-couplers at multi-channel sites
  - 4. Grounding kits and lightning protection devices, per Contractor selected standard in Section 1.2.C
  - 5. Mounting hardware for antennas, transmission lines, RF filter products, grounding kits, and lightning protection devices
- B. The Contractor shall supply and install a new VHF transmit combiner and receive multi-coupler system at sites that will have multiple channels.
- C. The Contractor shall fully describe expansion capacity for new combiner and multi-coupler systems.
- D. Antenna systems shall:
  - 1. Provide the required guaranteed coverage
  - 2. Match the antenna design used for all coverage modeling





3. Meet applicable FCC rules and regulations
  - E. Antennas shall be selected to perform in and endure the anticipated environmental conditions. High elevation mountain, desert, high wind and/or salt air locations 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. Some existing repeaters are licensed for and use directional and/or down tilt transmit antennas. The Contractor shall not alter the existing antenna's radiation pattern without the District's prior written concurrence.

## **1.5 Backhaul Network Requirements**

### **1.5.1 General Backhaul Requirements**

- A. All existing sites and VHF analog conventional repeaters for the XSD CMD 9, and 15 channels shall be connected to the existing RCS backhaul network.
- B. The Contractor shall refer to Appendix B for details on the existing microwave system. The Contractor shall evaluate and leverage existing microwave equipment to the extent possible.
- C. If existing or available backhaul network cannot support the proposed LMR system, the Contractor shall provide new backhaul connectivity via optical fiber and/or new microwave equipment (including antenna systems).
- D. New backhaul equipment shall be implemented for new RF sites not part of the existing LMR system.
- E. The Contractor shall be solely responsible for the new microwave radio system performing as specified in this RFP and to be compliant with all new or modified FCC radio station licenses.
- F. If any of the links will not meet the minimum capacity and availability specifications, the Contractor shall identify an alternate path to another RCS microwave backhaul site that will.
- G. If the same link is used to connect VHF repeaters to the RCS microwave backhaul system for multiple zones, the Contractor shall furnish one link that will meet the capacity needs for all zones.





- H. The 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
- I. The Contractor shall provide backhaul network diagrams showing required connectivity (physical and logical) between all proposed sites.
- J. The Contractor shall specify Layer 2 and Layer 3 networking requirements and provide an IP addressing scheme/plan on a per-device/per-site basis.
- K. The Contractor shall specify the recommended connectivity type (i.e., fiber, ring, spur) for each site in the proposed system design.
- L. The Contractor shall specify where redundant backhaul connections are recommended for maximum availability in the proposed system design.
- M. The Contractor shall develop and maintain a spreadsheet that identifies the backhaul requirements on a per-hop (or per-site) basis.
- N. The Contractor shall specify test(s) (such as RFC 2544) to be completed to validate that the backhaul network meets the Contractor's system requirements.
- O. Prior to site installations, the Contractor shall provide a schedule (on a per-site basis) for site installations and optimization so that the District can verify that the backhaul is ready prior to Contractor functional testing.

### **1.5.2 General Microwave Requirements**

- A. The new microwave backhaul system requirements are:
  - 1. The 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 District prefers a fault tolerant backhaul design. If not possible, the use of microwave spurs shall be pre-approved by the District. 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. The 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 County and/or District 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 District.
  - 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. The 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 District 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.

### **1.5.3 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 100 Mbps and maximum capacity of 200 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. The 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.





### **1.5.4 Microwave Backhaul Equipment**

#### **1.5.4.1 Microwave Radios**

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

#### ***1.5.4.2 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 14°F to 122°F, and 0% to 95% humidity (non-condensing).
- D. ODU's shall operate to specification from -25 °F to 155 °F, 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.

#### **1.5.4.3 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.

#### **1.5.4.4 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

#### **1.5.4.5 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 District 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. The 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





## **1.6 Heartland Communications Facility**

- A. The dispatch consoles at Heartland Communications Facility shall be configured and tested with replacement of repeater(s) at any existing site(s) in the radio system.
- B. The dispatch consoles at Heartland Communications Facility shall be configured and tested (including patching) with any new site(s) and/or channel(s) added to the radio system.
- C. The dispatch system shall include interop / conventional channel gateway(s) for interfacing and patching between P25 trunked talkgroups and analog/conventional Mutual Aid channels.
- D. The logging recorder at Heartland Communications Facility shall be configured and tested with replacement and/or addition of channel(s) at any existing and/or new site(s) in the radio system.

## **1.7 Optional Network Management System**

- A. The LMR 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. The NMS shall be equipped with new network management terminals (NMT) installed in two locations: Dispatch center; and one other to be determined by the District.
- D. Each RF site shall include a small remote terminal unit (RTU) for monitoring/reporting of physical site alarms (i.e., temperature, intrusion, generator, etc.).
- E. 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.





## 2. Site Improvements

### 2.1 General Requirements

- 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. The Contractor shall reference information about existing site infrastructure and conditions in the following appendices:
  - 1. Appendix B – SunWireless Public Safety Radio and Microwave System Backhaul Study for Heartland Communications\_012323 (1).pdf
  - 2. Appendix C – VHF GAP Analysis San Diego MAIN\_A. (1).pdf
- C. The Contractor shall identify and propose any additional work necessary to make radio sites and infrastructure usable for the new LMR system and microwave backhaul. The Contractor shall be responsible for site improvements based on deficiencies discovered through the site surveys.
- D. The Contractor shall perform structural analyses on all existing towers. If no current drawings are available, the Contractor shall conduct the tower mapping as required for the structural analysis.
  - 1. Structural analysis shall be performed on existing towers 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 District's intent that the Contractor remove unused system equipment upon system acceptance
  - 3. Structural analysis reports shall be provided to the District upon completion
  - 4. If a tower fails the structural analysis, the Contractor shall consult with the District to determine how to proceed.
- E. The Contractor shall perform site grounding upgrades for their selected sites to be compliant with their selected grounding and lightning protection standards.
- F. The Contractor shall identify and propose any additional work necessary to make radio sites and infrastructure usable for the new LMR system and microwave







backhaul network. The Contractor shall consult with the District to determine how to proceed with site improvements identified during the site surveys that are not identified in this section.

- G. The Contractor shall complete any documents required by local, state, and federal departments including, but not limited to permitting documents, State Historic Preservation Office (SHPO), National Environmental Policy Act (NEPA), and California Environmental Quality Act (CEQA) processes.
- H. 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. The Contractor and their subcontractor(s) shall comply with all applicable local codes as well as industry best practices and guidelines stipulated in Section 1. 2, *Standards and Guidelines*
- I. The 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
- J. The Contractor shall coordinate with utility companies for all utility related items, such as electrical service hookups and disconnects.





## **2.2 Equipment Enclosures**

### **2.2.1 Equipment Racks**

- A. Where space is available within existing equipment shelters, the Contractor shall provide racks meeting the following minimum specifications:
1. Standard 19" EIA-310 racks with 17 ¾" minimum opening
  2. Zone 4 seismic rating
  3. 7-foot high
  4. Drilled and tapped for #12-24 screws spaced for 1-3/4" high Rack Unit (RU) panel mounting on front and rear rails
  5. Have 1" angle top mounting brackets on front and rear face
  6. Equipped with vertical cable raceways and horizontal cable management panels
  7. Equipment rack shall support no less than a 1,000-pound equipment load
  8. New equipment racks shall be furnished with an A/B fuse distribution panel capable of distributing -48 VDC to all equipment in the rack. The fuse panel shall be furnished with a blown fuse alarm for remote monitoring

### **2.2.2 Outdoor Cabinets**

- A. Where space is not available within existing equipment shelters, the Contractor shall provide outdoor communications equipment cabinets that meets the following minimum requirements:
1. Support all LMR, backhaul, and associated equipment at a site
  2. Height – up to a maximum of 72" inches
  3. Be designed for installation outside, including an air conditioner to maintain an internal cabinet temperature within the operational range of the installed equipment
  4. Have front and rear full-length doors





5. Have mounting rails designed to mount standard 19-inch equipment and subassemblies. Mounting holes shall be spaced vertically to provide 1.75-inch units.

## **2.3 Site Generator**

### **2.3.1 General**

- A. The Contractor may recommend reuse of existing generators based on the site survey findings. The District shall approve reuse of any existing site generators.
- B. If required, the Contractor shall supply a new site generator for new and/or existing sites.
- C. The Contractor shall supply a new site generator for existing sites based on deficiencies discovered through their site surveys.
- D. The Contractor shall supply and install new generators that comply with the Outdoor-Use Units specifications in UL 2200, latest edition.

### **2.3.2 Power and Electric Requirements**

Generator specifications include the following:

- A. Fuel: Liquid Propane (natural gas or diesel may be provided as an option)
- B. Output: 30 kW (minimum, and sized for the proposed system)
- C. Phase: Single
- D. Voltage: 120/240 VAC
- E. Frequency: 60 Hz

### **2.3.3 Enclosure**

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

### **2.3.4 Muffler Type**

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





### **2.3.5 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"





### **2.3.6 Miscellaneous**

- A. Generator will be supplied with block heater, 10 Amp battery charger, and meet NFPA99 and 110 requirements.
- B. Fuel tanks shall be sized to accommodate for a 7-day run time with a minimum size of 500 gallons.
- C. The 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 fuel threshold shall be programmable.
- E. Fuel tanks shall be securely attached to a poured concrete foundation.

### **2.3.7 Automatic Transfer Switch (ATS)**

- A. The 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.

## **2.4 Tower Structure**

### **2.4.1 General**

- A. The Contractor shall leverage existing building rooftop structures to the extent possible.
- B. The 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. The Contractor may recommend reuse of existing towers based on the site survey findings and structural analysis results. The District 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.

### **2.4.2 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.

### **2.4.3 Waveguide Support**

- A. There shall be a ladder type support system associated with the tower to mount the transmission cables.
- 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.

#### **2.4.4 Waveguide Bridge**

The tower shall be equipped with a waveguide bridge with support posts spaced at intervals compliant to the wind loading specifications, but not more than 10 feet distant.

- A. There shall be posts placed on both lateral sides of the bridge to fully support the load.
- B. The bridge shall be designed to support all initial antenna transmission lines plus 25% growth capacity.
- C. The structure shall comply with the tower wind and ice requirements as specified in TIA -222 Standard current revision.
- D. The Contractor shall furnish and install the waveguide bridge between the tower and equipment shelter.
- E. 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 in width
  - 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. Waveguide bridge shall be adjustable in height to allow interface with shelter waveguide entry ports
11. Waveguide Bridge shall be effectively grounded to the external ground bar

### **2.4.5 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.

### **2.5 Power Systems**

- A. The Contractor shall evaluate and leverage existing primary and backup power systems.
- B. The Contractor may recommend reuse of existing backup power systems based on the site survey findings. The District shall approve reuse of any existing backup power systems.
- C. Based on existing site configuration, the Contractor may include new DC power systems for site(s) where new equipment is proposed. Where new DC power system is required, the Contractor shall refer to Section 2.6.1.
- D. Based on existing site configuration, the Contractor may include a new Uninterruptible Power Supply (UPS) for site(s) where new equipment is proposed. Where new UPS is required, the Contractor shall refer to Section 2.6.2.

#### **2.5.1 DC Power Requirements**

- A. LMR and microwave equipment at all RF sites shall operate on primary DC power with the ability for all equipment to operate for 10 hours upon failure of primary AC power.







- B. The DC power system shall be designed to meet the specific load requirements for all system equipment at each site and include enough capacity for an additional future load of 25% of the equipment furnished under this contract.
- C. 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
- D. The DC power system shall perform as specified herein when housed with or adjacent to other radio transmitters operating in accordance with FCC regulations.
- E. 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.
- F. The power supply/charger shall meet the following requirements:
  - 1. Input Voltage: single phase, 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: +/- 1/2% 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 and microwave radio 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
- G. The 48-volt 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 during an AC power failure for a minimum of 8 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 service life of 10 years, defined as the time in which the battery capacity drops below 80% of the original capacity

H. Other DC Power System Components:

1. Load distribution/disconnect panels shall:
  - a. Include individual 100A 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





- I. As an option for site(s) without commercial AC power available, the system shall include a solar power generating system complete with the following components and capacity to support the site(s) radio, backhaul, and HVAC equipment:
  1. Solar array
  2. Charge controller
  3. Battery bank
  4. Battery enclosure
  5. Required wiring and cables

### ***2.5.2 Uninterruptible Power Supply Requirements***

- A. The UPS shall be a single phase, online, double conversion, static type 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. Remote UPS monitoring provisions
  11. Battery monitoring
  12. UPS output shall be connected to a dedicated subpanel feeding quad 20A twist lock outlets to be installed on the overhead cable tray
- B. 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.

C. Performance Requirements:

1. Input:
  - a. Single phase, three-wire
  - b. Voltage: 120/240V Nominal
  - c. Frequency: 50/60 Hz +/- 3 Hz
2. Output:
  - a. Voltage: 120/240V
  - b. Frequency: 60 Hz, +/- 3 Hz
  - c. Maximum Voltage Distortion: 5% at full load
  - d. 30-minute battery operation





### **3. System Implementation, Test and Acceptance**

#### **3.1 Project Management**

- A. The Contractor shall attend project and construction meetings as deemed necessary by the District prior to and during installation. Additional meetings may be scheduled at the discretion of the District.
- B. If any changes in the overall timeline occur, the Contractor shall update the project schedule for discussion during these project meetings.
- C. The Contractor shall provide written minutes of all meetings no later than five business days after the meeting.

##### **3.1.1 Project Staffing**

- A. The 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 for the duration of the project unless the Contractor proposes an alternative plan to the District for consideration and gains approval.
- C. The District reserves the right to accept or reject any proposed staffing changes.
- D. The Contractor Project Manager
  - 1. The Project Manager shall be the primary point of contact between the District and the Contractor.
  - 2. The Project Manager shall bear full responsibility for supervising and coordinating the installation and deployment of the communications system.
  - 3. The Project Manager shall be responsible for:
    - a. Development and acceptance of the project management plan
    - b. Managing the execution of the project against that plan
    - c. Overseeing the day-to-day project activities, deliverables, and milestone completion
  - 4. The Project Manager shall be responsible for coordinating and facilitating weekly status meetings.





E. The Contractor's Systems Engineer

1. The Systems Engineer shall be responsible for managing the system design and ensuring system installation in accordance with the approved system design.
2. Any deviation from the proposed system design shall be subject to project change control procedures and will not be undertaken until approved by the District.
3. The Systems Engineer shall ensure the accurate development of block diagrams, system-level diagrams, and rack diagrams.
4. The project engineer shall supervise the development and execution of:
  - a. Acceptance Test Plan (ATP)
  - b. Coverage Acceptance Test Plan (CATP)
5. The Systems Engineer shall guide the project team through the processes and procedures necessary to prove that the system performs as specified in the contract.
6. The District shall approve all test plans prior to execution.

**3.1.2 Scheduling**

- A. The Contractor's Project Manager shall develop and maintain a project schedule including tasks, milestones, start and end dates, task predecessors, and task owners based on an approved WBS.
- B. The schedule shall represent tasks associated with completing work on all items identified in the WBS.
- C. The Contractor shall update the project schedule with actual dates as tasks are completed.
- D. The Contractor shall present all schedule updates to the District during the weekly status meetings.
- E. The schedule shall address the following 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. System Acceptance Testing
13. Field Acceptance Testing
14. User training
15. System cutover
16. System documentation development and delivery
17. System and equipment warranty

### **3.1.3 Project Meetings**

- A. The Contractor shall schedule a project kickoff meeting prior to beginning project work.
- B. The Contractor shall schedule weekly project status meetings following contract award and the project kickoff meeting.
- C. Weekly status meetings shall continue through the duration of the project until the District issues final system acceptance.
- D. The Contractor shall be responsible for facilitating the weekly status meetings





- E. The Contractor shall prepare and distribute meeting agendas to the District via e-mail on a weekly basis. Agendas must be distributed at least 24-hours prior to each scheduled meeting and minutes no later than 24-hours after each meeting.
- F. 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

#### **3.1.4 QA/QC Plan**

- A. The Contractor shall submit a project quality assurance (QA)/quality control (QC) plan for District review.
- 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 Contractor's Project Manager.
3. Be an integral part of the project.
4. Include the District personnel as part of the review and approval process for all deliverables and submittals.
5. The proposed QA/QC plan shall 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

### **3.1.5 Project Punch List**

- A. The Contractor shall establish and maintain a punch list, as mutually agreed to with the District.
- B. The punch list shall address all open issues including those related to sites, facilities, equipment, and acceptance tests.
- C. The Contractor shall maintain the punch list in real time.





- D. The Contractor shall distribute the punch list to the District weekly via e-mail.
- E. 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
- F. If the Contractor receives written permission from the District 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.
- G. The Contractor shall be responsible for reviewing each punch list item and advising the District of any changes.
- H. The Contractor shall update the status of punch list items during each weekly status meeting.

### **3.1.6 Background Checks**

- A. The 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 the District's facilities, radio systems, network, data, or other sensitive information.
- B. The scope of the background check is at the discretion of the District and may include polygraph and/or Computer Voice Stress Analysis (CVSA). The decision of the District is final. The cost of attending the background investigation shall be the responsibility of the Contractor.





### 3.2 Site Surveys

- A. The Contractor shall participate in a mandatory site survey with the District to confirm actual equipment location within each space prior to the start of the system installation.
- B. During the mandatory site survey, the Contractor shall determine and document any changes needed to the detailed design installation drawings. All detailed design drawings and documents requiring changes shall be revised prior to installation and review by the District.
- C. The 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) listed in Section 1.2.
  - 4. Identify existing equipment that can be reused on the new system
- D. The 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 tower 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.jpeg”) 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 new 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 MS-Visio native format





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. The Contractor shall produce a Grounding Assessment report for each site, based on the standard(s) selected in Section 1.2. 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 new 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

### **3.3 Microwave Path Design**

- A. The 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. The Contractor shall perform an independent analysis of all radio paths for propagation outage and availability calculations to ensure that all radio paths will meet the path availability requirements.







### **3.4 Detailed Design**

- A. The Contractor shall submit a Detailed Design package within 60 days after contract award, which shall include the following:
1. Any updates to previously submitted design information
  2. System block diagrams
  3. Radio channel/frequency plan(s)
  4. Bandwidth requirements and calculations
  5. IP addressing scheme and plan
  6. Migration/Cutover plan:
    - a. A preliminary cutover plan describing how the radio system will be phased over into a fully operational system.
    - b. The Contractor shall successfully complete all tests and training prior to the actual cutover of systems.
    - c. The Contractor shall provide the necessary labor to cutover from existing systems to the proposed system.
    - d. The 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 new system with minimal operational impact.
    - e. The plan shall provide detailed component or subsystem cutover plans, and specifically delineate between systems that affect and do not affect ongoing operations.
    - f. The District reserves the right to approve and change the cutover plan as it relates to any or all system components.
- B. Coverage Acceptance Test Plan (CATP), complete with coverage overview, service area definitions and grid structures, talk-in and talk-out test procedures, Contractor and District responsibilities, and sample pass/fail sheet
- C. Sample factory testing documentation for each piece of equipment





- D. System installation, optimization, operation, and maintenance manuals for all equipment
- E. Blank site installation, grounding remediation, and optimization documents to be completed during and after installation and provided with as-built documentation
- F. 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)
  - 1. Structural analysis for failed tower and/or foundation shall detail the required or recommended modifications for tower and/or foundation remediation
  - 2. Sites without a completed structural analysis, tower mapping, and/or remediation pricing shall not be presented at Detailed Design Review
- G. Complete Detailed Design package for each site, consisting at a minimum the following content:
  - 1. Cover page with site name, site type (repeater, microwave, etc.), Zone name (North, Central, or East), technology (analog, conventional, P25 Phase 1, , 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, and ownership (land, tower, shelter)
  - 2. Index page with sheet titles, drawing descriptions, drawing versions, and page numbers
  - 3. Block diagram(s) showing entire network and any region- or subsystem-specific diagram
  - 4. Mobile and Portable Talk-in and Talk-out coverage maps
  - 5. Site plan showing existing and/or proposed site compound, tower(s), and shelter(s), all to scale and orientation
  - 6. 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
  - 7. 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
8. 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
  9. 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
  10. 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
  11. Detailed antenna system drawings for proposed base station transmit and receive antennas, TTAs, GPS, and/or microwave dishes, complete with quantities, model numbers, and configuration/interconnection
  12. 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 for
  13. Interior and exterior site grounding system drawings
  14. Site-specific frequency and combiner plans
  15. Network equipment interconnection drawings showing router and switch connections, with cables and port numbers labeled and color-coded
  16. Site-specific IP addressing scheme, showing host names, host addresses, subnet mask, equipment use/description, and configuration-specific notes
  17. Patching schedules and termination details for all cabling necessary for a complete record of the installation
  18. Location of demarcation points for any items to be provided by the District
  19. Site-specific bill of materials for all new equipment to be installed at the site
  20. Site remediation summary (with pricing) based on results from Site Survey report, Grounding Assessment report, and Structural Analysis report





- H. The Contractor shall submit a Draft Factory Acceptance Test Plan (FATP) outlining a comprehensive series of tests that will demonstrate proof of performance and readiness for shipment.
- I. The Contractor shall submit a Draft System Acceptance Test Plan (SATP) outlining a comprehensive series of tests that will demonstrate proof of performance after installation and optimization is complete.
- J. 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.
- K. Any other items as required or requested by the District prior to Detailed Design Review.
- L. All items required for detail design shall be submitted to the District 10 business days prior to the detailed design review meeting.

### ***3.5 Detailed Design Review***

- A. A detailed design review meeting shall be conducted to allow the Contractor to present the system detailed design for review and approval.
- B. The design review meeting shall be scheduled no sooner than one week after delivery of the Detailed Design Package to the District, to allow for review time prior to the meeting.
- C. The Contractor shall update and resubmit their Detailed Design Package based on review comments from the District.
- D. The detailed design review shall be considered the last step prior to ordering and/or manufacturing of equipment. Upon approval of the detailed design by the District, the Contractor may begin the ordering and manufacturing of system equipment. The District shall not be held liable for any equipment ordered or manufactured prior to approval of the detailed design.

### ***3.6 Frequency Coordination and Licensing***

- A. The District currently operates on VHF channels and will provide all current licensing information to the Contractor following contract award.





- B. The District anticipates remaining on the same frequency band and/or channels for the proposed system.
- C. The Contractor shall leverage the current VHF licenses, with additional frequency research, coordination, and licensing if needed to support all proposed channels and sites.
- D. The Contractor shall complete all engineering tasks required for channel 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 submission of license applications to the FCC.
- E. The Contractor shall coordinate with the Federal Aviation Administration (FAA), National Environmental Protection Act (NEPA) and regional and/or local municipalities, as required for this project, on behalf of the District.
- F. The Contractor shall complete and submit FAA forms for antenna structures.
- G. The Contractor shall complete all required FCC construction deadline notifications.
- H. The Contractor shall ensure compliance with the FCC's Maximum Permissible Exposure (MPE) requirements.
- I. The Contractor shall provide copies of each license to the District.
- J. The Contractor shall track all applications and filings with the selected frequency coordinator and/or the FCC.
- K. The Contractor shall respond to any questions by the selected frequency coordinator and/or the FCC regarding all applications and filings.
- L. The Contractor shall 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.

### **3.6.1 Intermodulation Interference**

- A. The 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 following implementation, the Contractor shall resolve the issue without degrading system





coverage or performance for a period of up to 12 months after System Acceptance and at no cost to the District.

- C. Transmitters at each site shall meet FCC Maximum Permissible Exposure (MPE) standards (per latest revision of FCC Office of Engineering and Technology (OET) Bulletin 65).
  - 1. All transmit signals from all tenants located at the site, per FCC licensed information
- D. The Contractor shall mitigate causal and occupational exposure at locations that exceed MPE standards
  - 1. Fencing, signage, and/or other techniques shall be approved in advance by the District.

### **3.7 Staging**

- A. Each individual assembly or equipment unit shall undergo factory testing prior to shipment.
- B. The Contractor shall submit standard factory test documentation, documenting the tests performed and indicating successful completion of testing to the District.
- C. System staging:
  - 1. The Contractor shall perform complete system staging and testing at a location in the United States.
  - 2. To minimize travel and expenses, the District prefers that staging of the radio and microwave systems be completed at the same time and location.
  - 3. The intent of the staging tests is to demonstrate to the District that the radio and microwave systems are ready for shipment and installation.
  - 4. The Contractor shall provide all necessary technical personnel, and test equipment to conduct staging tests.
  - 5. All deviations, anomalies, and test failures shall be resolved at the Contractor's expense.
  - 6. The Contractor shall use an approved staging acceptance test plan (SATP).





7. The Contractor shall successfully perform all tests before the District witnesses the official SATP.
8. The Contractor and the District shall jointly execute and date the SATP following completion of all tests.
9. All tests in the SATP shall be marked as either pass or fail.
10. The Contractor shall document all failed components.
11. The Contractor shall correct and retest all failed components.
12. The Contractor shall replace at its own expense failed components that are not repairable.
13. The decision to retest an individual failed SATP tests or the entire plan shall be at the District's discretion.
14. The Contractor shall provide the District with the fully executed and complete SATP document.
15. There shall be no deemed acceptance of the SATP.

### ***3.8 Shipping and Warehousing***

- A. The Contractor shall ship and warehouse all equipment and materials at its own expense. The District will not store equipment.
- B. The Contractor shall be responsible for transporting LMR and backhaul equipment to and from the Contractor's warehouse(s) and the District sites.
- C. The Contractor maintains all liability and risk for all equipment until it has been installed at the site.

### ***3.9 System Installation***

#### ***3.9.1 General Requirements***

- A. The Contractor shall install all equipment, antennas and associated materials described herein in strict conformance to the manufacturer's recommendations and using good craftsmanship.





- B. The Contractor is responsible for qualified, trained personnel experienced with this type of work, to perform all configurations and installations.
  - 1. The District shall preapprove all subcontractors.
  - 2. The District shall preapprove any change in subcontractor or its staff.
- C. Installation shall consist of a complete tested system to include placement of associated cabling, appropriate system layout, and terminal connections.
- D. The Contractor shall provide associated power supplies and any other hardware, adapters, and/ or connections to deliver a complete operable system to the District.
- E. All detailed design drawings and documents requiring changes shall be revised prior to installation.
- F. The 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.
- G. The Contractor shall provide and pay for all materials necessary for the execution and completion of all work.
- H. Unless otherwise specified, all materials incorporated into the permanent work shall be new and shall meet the requirements of this RFP.
  - I. The Contractor shall be responsible for preparing and submitting the necessary applications for site permissions/access to install system equipment at non-District owned sites.
  - J. The Contractor shall be responsible for any leases at non-District owned sites for temporary space needed during installation and cutover to the new system.
  - K. The 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.

### **3.9.2 Antenna and Feedline Installation**

- A. All antennas, RF cable and waveguide shall be tested and verified to meet the manufacturer specifications. Any antenna, RF cable or waveguide not meeting







specification shall be replaced with new equivalent products, at the District discretion.

- B. All antenna work shall be accomplished in compliance with the terms of the FCC licenses granted to the District.
- C. The Contractor shall install radio frequency (RF) cable and waveguide without kinks or dents. Such installations shall not exceed manufacturer specified bending radii.
- D. RF cable and waveguide shall be secured to the radio tower at manufacturer recommended intervals using hangers designed specifically for the tower and type of RF cable used.
- E. The Contractor shall install a coaxial cable lightning arrestor for all coaxial cable runs.
- F. The Contractor shall install cable grounding kits on the RF cable at three outdoor locations; immediately behind or below the antenna, at the base of the tower immediately above where each cable leaves the tower and near the building waveguide entry.
- G. The Contractor shall weatherproof each outside RF and IF cable jacket penetration (connectors and grounding kits) using a weatherproof kit.

### **3.9.3 Equipment Racks and Cables**

- A. Equipment installation will be compliant with all applicable standards for seismic bracing.
- B. 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.
- C. Bracing of equipment is required during unattended periods of construction.
- D. All cables for rack-mounted and wall-mounted equipment shall be cut to length and include a 96-inch service loop neatly fastened to rack cable standoffs or ceiling trays as appropriate. Excess cabling is not acceptable.
- E. Industry standard cable management shall be used for the installation of all cabling.





- F. All cabling shall be labeled with an identifier on each end that clearly indicates where the cable is terminated at both ends.
- G. The Contractor shall clean all equipment and devices and repair all damaged finishes.
- H. The Contractor shall not use equipment supplied as spares for installation of the new system.

#### **3.9.4 Work Sites**

- A. The Contractor shall leave sites neat and broom swept upon completion of work each day.
- B. The Contractor shall thoroughly clean all equipment shelter and building floors and remove all scuff marks and abrasions prior to acceptance.
- C. The Contractor shall remove all trash weekly.

#### **3.9.5 Inspection**

- A. All materials furnished and work completed shall be subject to inspection by the District.
- B. The District shall conduct an inspection of the installations upon substantial completion.
- C. The District shall document any deficiencies on a single punch list and provide the punch list to the Contractor for resolution.
- D. Final acceptance testing shall not commence until all punch list items are resolved.

#### **3.10 Coverage Testing**

- A. The Contractor shall submit a Coverage Acceptance Test Plan (CATP) that will validate the coverage requirements.
- B. The CATP shall comply with the following requirements:
  - 1. The CATP shall be consistent with the procedures and guidelines outlined in TSB-88 (current version).





2. Coverage testing shall commence only after the radio system is fully optimized, tested and aligned.
  3. After successful completion of the CATP, should any significant changes occur on a channel(s) prior to system acceptance, the channel(s) coverage will require retesting at the District discretion. The District shall not be responsible for any additional costs associated with the retesting.
  4. The CATP shall be conducted during periods of full foliage as determined by a governmental body that can adequately determine leaf-on and leaf-off dates, such as the United States Forest Service.
  5. The Contractor shall perform the following types of coverage testing in both directions (talk-out and talk-in):
    - a. Objective drive testing, which shall measure signal strength to/from simulated portable radios (on-street).
    - b. Subjective talk-out and talk-in DAQ testing, measuring perceived audio quality to/from simulated portable radios (on-street).
- C. On-street portable radio subjective testing will be used to verify that coverage requirements are met. The Contractor shall provide the results of the objective tests to the District for information only.
- D. Test configurations:
1. 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, and the attenuator values required to simulate those locations (as well as all factors used to calculate the attenuator values) shall be submitted to the District for their review and approval prior to testing.
  2. Objective drive testing:
    - a. The Contractor shall test on-street signal level (RSSI) using a portable to be used on the system. Any potential line loss/insertion loss/antenna correction factors, if the portable is proposed to be routed to an external antenna, shall be identified in the proposal,





- and also shall be measured by the Contractor and approved by the District prior to the start of the testing.
- b. The Contractor shall test at a statistically significant number of test locations throughout the guaranteed coverage area of each channel. The Contractor will work with the District to identify test locations. Methods for determining the minimum number of tiles are provided in TSB-88.
3. Non-automated subjective DAQ testing:
- a. The Contractor shall perform on-street non-automated subjective DAQ coverage testing using portable radios typical of the system, in their proper configuration (e.g. shoulder-mounted antenna, Bluetooth speaker mic, etc.). Any potential line loss/insertion loss/antenna correction factors, if the portable is proposed to be routed to an external antenna, shall be identified in the proposal, and also shall be measured by the Contractor and approved by the District prior to the start of the testing.
  - b. The Contractor shall test at a statistically significant number of test locations throughout the guaranteed coverage area of each channel. Methods for determining the minimum number of tiles are provided in TSB-88.
- E. For testing purposes, each channel's guaranteed coverage area (as determined by the Contractor) shall be divided into 1/4-mile square test tiles (.25-mile x .25-mile). The Contractor may subdivide test tiles if necessary.
- F. The Contractor shall not count inaccessible (i.e. paved and unpaved roads not accessible by 4WD vehicle) test tiles as either a pass or fail in the statistical analysis.
- G. The Contractor shall document talk-out and talk-in performance separately for each test tile, and the overall system pass/fail percentages shall be calculated for each direction distinctly.
- H. Subjective DAQ testing shall show that 95% of the tiles tested within the guaranteed coverage area for each channel, in the talk-in as well as talk-out direction, were at a DAQ 3.4 or better audio quality level. If it is determined that more than 5% of the tiles tested have an audio quality level of less than DAQ 3.4, it shall be deemed a failed test. The Contractor shall assess the cause of the failed





test, make any necessary corrections if needed, and **re-conduct the coverage test in its entirety. The Contractor will be solely responsible for the cost of any system corrections and re-testing.**

- I. The Contractor shall provide a standardized test form for testing.

### **3.11 Acceptance Tests**

#### **3.11.1 General Requirements**

- 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 2 weeks written notice to the District that the system is ready
  3. Submit a Test Plan for review and approval by the District
- B. The Contractor shall provide all test equipment and miscellaneous cables, adapters and parts required to perform all testing specified in this RFP.
- C. The Contractor shall calibrate all test equipment prior to testing.
- D. Performance of all tests must be in the presence of the District or a District-approved representative.
- E. Testing requires the utilization of quality instruments in proper condition for all testing. Calibration records for all instruments shall be available at the site during all testing.
- F. Contractor and District representative shall sign the Acceptance Test Plan following successful completion of all tests. All tests in the Acceptance Test Plan shall be marked as either pass or fail.
- G. The Contractor shall submit all test schedules to the District for approval.
- H. The Contractor shall provide all necessary technical personnel and test equipment to conduct Acceptance Testing. All deviations, anomalies, and test failures shall be resolved at the Contractor's expense.





- I. The Contractor shall document, repair, replace and retest any equipment that fails any test. The Contractor shall replace and retest all defective components.
- J. The District reserves the right to require retesting of any equipment that fails any test, after repair or replacement.

### **3.11.2 LMR Acceptance Testing**

- A. LMR Final Acceptance Test Plan (FATP):
  - 1. The Contractor shall use the completed and approved FATP.
  - 2. The Contractor shall successfully perform all FATP tests before the District witnesses the official FATP.
  - 3. The Contractor and the District representatives shall jointly execute and date the FATP following completion of all tests.
    - a. All tests in the FATP shall be marked as either pass or fail.
  - 4. The Contractor shall provide all necessary technical personnel and test equipment to conduct FATP tests.
  - 5. All deviations, anomalies and test failures shall be resolved at the Contractor's expense.
  - 6. The Contractor shall document, correct, and retest all failed components.
  - 7. The Contractor shall replace at its own expense any failed component that is not repairable.
  - 8. Retest of individual failed FATP tests or the entire plan shall be at the District's discretion.
  - 9. The Contractor shall provide the District with the fully executed and completed FATP document.
  - 10. No conditional acceptances will be granted.





### **3.11.3 Microwave Backhaul Acceptance Testing**

#### **3.11.3.1 Radio Path Tests**

- B. The Contractor shall perform the following tests for each radio path (including both sets of transmitters and receivers on hot standby systems):
1. Transmitter:
    - a. Measure and record the microwave radio transmit power at the antenna port of the radio.
    - b. Verify that the transmitter output frequency are set according to the FCC license using a web-based interface
    - 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 received signal level (RSL) under no-fade conditions and verify that it is within 3 dB of the expected value. If the RSL is not within 3 dB of the expected value, investigate and correct the issue before beginning the remaining tests described below

#### **3.11.3.2 Payload Performance**

- A. After successfully completing the Radio Path Tests, perform an RFC 2544 test, with the radio link at nominal RSL.
- B. Ethernet tests shall include throughput, latency, packet jitter and frame loss.

### **3.12 Training**

#### **3.12.1 Training Programs**

- A. The Contractor shall develop and conduct training programs to allow the District personnel to become knowledgeable with the system, subsystems, and individual equipment.





- B. The Contractor shall provide training for all new equipment, including, but limited to the conventional VHF repeaters, microwave radios, networking, and all associated equipment.
- C. The 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. Repeater Programming
    - b. Repeater Maintenance
    - c. Repeater Troubleshooting
    - d. Interference Analysis
    - e. Microwave radio maintenance, configuration, and troubleshooting
    - f. NMS maintenance, configuration, troubleshooting and report generation
- D. The Contractor shall provide system management training for technical staff responsible for managing the system, which shall include, but not be 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.
- E. The Contractor shall provide descriptions of all training programs they intend to provide, which shall include the following:
1. A list of all subjects with a description of each
  2. Class material to be provided by the Contractor
  3. Number of classes
  4. Class duration
  5. Need for recurring training
  6. Class size
  7. Class cost
- F. The Contractor shall conduct all training at a location where duplication of system operation will not impact daily operations.
- G. The Contractor shall coordinate with the District regarding number of attendees, schedule, and training location.
- H. The Contractor shall schedule classes as close to system cutover as possible.
- I. The Contractor shall train the District employees or designated individuals.

### **3.12.2 Training Materials**

- A. The 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 District and shall become property of the District.
- 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 must 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 District installation
  6. Color photos must be provided where detail or clarity is supported by use of color
  7. Black and white photocopying of color materials is unacceptable
- D. The Contractor shall provide fully editable (softcopy) versions of all training materials so that the District trainers can update the course materials.
- E. The Contractor shall provide unit pricing for all media (e.g., CDs, DVDs, and Manuals) used for training.
- F. The pricing provided shall be valid for a period of 3 years following system acceptance.

### **3.13 System Cutover**

#### **3.13.1 Cutover Plan**

- A. The Contractor shall develop a Cutover Plan for review and approval by the District. The District 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 must 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. The Contractor shall be responsible for planning and coordinating the implementation of all equipment, subsystems, and the overall system.
  3. The 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 must 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 District.
- B. The Cutover Plan shall demonstrate that it meets the following requirements:
1. Supports the operational requirements of each participating agency including.
  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 new system.





- D. The Cutover Plan shall include the schedule and procedures associated with the transition of each operational user group.
- E. The Cutover Plan shall specifically address how the existing users will begin using the new system with minimal operational impact.
- F. The Cutover Plan shall provide detailed component or subsystem cutover plans, and specifically delineate between systems that affect and do not affect ongoing operations.
- G. The District reserves the right to approve and change the Cutover Plan as it relates to any or all system components.

### **3.13.2 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 District at least ten business days prior to execution.
- C. The 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 District.
- D. The Contractor shall provide the necessary labor to cutover from existing systems to the new system.

### **3.14 30-Day Operational Verification Period**

- A. The Contractor shall plan a 30-calendar-day operational burn-in period for the entire 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 District.
- C. Technical staff from the District and the County and/or other designated experts shall monitor the burn-in period.
- D. The Contractor shall demonstrate the integrated operation, reliability, long-term stability, and maintainability of the system during this period.
- E. System must be fully loaded (all users must be fully migrated).





- F. A Critical failure of the system during this test will cause the burn-in period and warranty 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 coverage for a specific channel within the Central Zone
    - b. Any failure of one or more Contractor-supplied repeaters at any site within the Central Zone
    - c. Any failure of Contractor-supplied antenna system which causes a loss of voice communications at any site within the Central Zone
    - d. Any failure of one or more Contractor-supplied switches and/or routers at any site within the Central Zone
- G. A minor failure will cause the burn-in period to temporarily hold until the issue has been fully resolved to the District satisfaction.
  - 1. After resolution of the failure, and with District approval, the burn-in period will continue.
- H. Two or more repetitive minor failures of the same functionality with or without the same root cause shall be defined as a major failure.
- I. Two or more repetitive minor failures of the same piece of hardware with or without the same root cause shall be defined as a major failure.
- J. Two or more repetitive minor failures with the same root cause shall be defined as a major failure.
- K. 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 District is satisfied there is little likelihood of a systemic recurring issue.

### ***3.15 Decommissioning, Removal, and Disposal of Legacy Equipment***

- A. The Contractor shall remove existing equipment (e.g., transmitters, consoles, mobiles, cables, and antenna systems) not being reused in the new system or identified for future use by the District. This shall be done per the District code.





- B. The Contractor shall maintain a detailed inventory of all equipment removed, listing the following at a minimum:
  - 1. The owning department
  - 2. Model, serial, and asset numbers
  - 3. Location removed from
  - 4. Location within the warehouse
  - 5. Trade-in or disposition value
- C. The Contractor, at its sole expense, shall warehouse, as necessary, removed equipment prior to disposal.
- D. The Contractor, at its sole expense, shall transport all removed equipment to the District-specified disposal location.
- E. The District is interested in obtaining trade-in for all District-owned equipment that will be removed from service. At the request of the District, the Contractor shall provide a list of trade-in amounts.
- F. Equipment purchased by the Contractor as Trade-In shall be removed and handled according to the terms of any applicable Trade-in agreement.

### ***3.16 As-Built Documentation***

- A. The Contractor shall provide complete as-built documentation as outlined below:
  - 1. Equipment provided
  - 2. Plan and elevation drawings of all equipment including antennas on towers
  - 3. Shelter floor plans
  - 4. Cabling and terminations
  - 5. Block and level diagrams
  - 6. Fleet mapping and programming
  - 7. Licenses and permits





8. Setup, configuration, and alignment information, to include commissioning, provisioning, test, and turn-up
  9. Successfully completed, signed, and dated Coverage and Final Acceptance Test Plans
- B. The Contractor shall provide final documentation in printed form:
1. Six bound, hard copy, printed sets
  2. Hand modified drawings are not acceptable
  3. Hard copies of all drawings shall be 11" x 17"
- C. The Contractor shall provide final documentation on thumb drive:
1. All drawings provided in Microsoft Visio native format
  2. All other documentation provided in Microsoft Word or Excel format
  3. All drawings and documentation in Adobe Portable Document Format

### **3.17 System Acceptance**

- A. The District with the County shall deem the system ready for final acceptance following successful completion and approval of the following:
1. Final Detailed Design
  2. Staging Acceptance Test
  3. All contracted installation completed
  4. Final inspection and punch list resolution
  5. Coverage Acceptance Test
  6. System Acceptance Test
  7. Field Acceptance Test
  8. Final Acceptance Test
  9. Training completed





10. System cutover
  11. Successful completion of (30)-Day Burn-in test
  12. Delivery of As-built documentation
- B. No conditional acceptances will be granted.







## 4. Warranty, Maintenance, and Support

- A. Contractor support includes the initial 3-year warranty, software and firmware upgrade support, and spare parts and equipment.
- B. Should the Contractor be a system integrator, they will provide pricing and discounts per the final contract throughout the term of the final contract.

### 4.1 Warranty

- A. All equipment provided shall be new and covered by a full manufacturer's warranty for 3 years, commencing with system acceptance of LMR and microwave systems.
- B. System performance, installation, and all hardware, parts, software, and materials (including third-party equipment) shall be warranted for a period of 3 years.
- C. Warranty coverage shall include all related return and delivery fees.
- D. As an option, the Contractor shall provide their top tier of 24 hours a day, 7 days a week, 365 days a year on-site support for annual increments (years 4-10) following expiration of warranty.
- E. The 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.
- F. Following expiration of warranty, the District's technical staff shall be the first line of maintenance with the Contractor providing support as required.
  - 1. The District's personnel will escort the Contractor to all sites requiring Contractor level on-site support.
- G. 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.
- H. The District shall have the right to perform any maintenance and/or repairs required during the warranty period without voiding or affecting the Contractor's warranty.





- I. If Contractor level support is required, the following repair response time and repair-completed time criteria shall be in effect:
  1. The Contractor shall contact the District within 30 minutes of telephone notification for a Critical Service issue.
  2. The District 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 for a specific channel within the Central Zone
    - b. Any failure of one or more Contractor-supplied repeaters at any site within the Central Zone
    - c. Any failure of Contractor-supplied antenna system which causes a loss of voice communications at any site within the Central Zone
    - d. Any failure of one or more Contractor-supplied switches and/or routers at any site within the Central Zone
  3. The Contractor's qualified service representative and the District'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 District's representative cannot resolve the issue remotely or over the phone, then the District 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. The Contractor's qualified service representative shall be physically present at the site that requires service within 4 hours of the District'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.
- J. The Contractor shall repair all equipment, hardware, and software throughout the implementation, cutover and warranty periods.





- K. The following procedures shall be followed during the warranty period:
  - 1. The Contractor shall provide the District 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 District-owned spares to complete a repair, the documentation shall include the model and serial number of both the defective unit and the spare.
  - 3. Hardware:
    - a. For all equipment needing factory or depot repairs, the Contractor shall maintain a comprehensive tracking system to track units to and from the factory/depot.
- L. Replacement parts shall be new or original repaired parts only.
- M. Fixed equipment mail-in board repair shall be completed within seven calendar days of receipt.
- N. Equipment must be returned to the District via second-day shipping, with tracking number provided to the District.
- O. Serialized units sent in for depot repair must not be exchanged unless specifically authorized by the District.
- P. The original unit must be repaired and returned unless specifically authorized by the District.
- Q. Software and Firmware:
  - 1. The Contractor shall warrant all software and firmware.
- R. During the installation, warranty, and extended warranty periods, the Contractor shall provide, at no additional cost, commercially available upgrades of all software and firmware originally sold to the District.





- S. The frequency and timing of installation of upgrades during this period shall be at the sole discretion of the District based on availability by the Contractor.
- T. The Contractor shall provide all back-up media and revised software manuals to the District at the time of any software revisions at no cost.
- U. The Contractor shall update all devices to the same and latest release level prior to the conclusion of the warranty period at no additional cost to the District.
- V. 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 the District.
    - a. If the defect is deemed by the District to be systemic after the investigation is completed, the Contractor shall then be responsible for replacing at no additional cost to the District all equipment and/or equipment modules related to the recurring or systemic failure, not only the specific equipment affected.
- W. The Contractor, at no additional cost to the District, shall correct latent design defects or recurring problems relating to software, firmware, hardware, or overall system design, during the warranty period.
- X. During the warranty period, the Contractor shall correct all system malfunctions due to software at no additional cost to the District.
- Y. If, during the first 5 years after System Acceptance, 25% of any type of Contractor supplied equipment or material fails, Contractor shall replace this equipment or material at no additional cost to the District.

#### **4.2 Parts Availability**

- A. The 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 District 24 months prior to the date of discontinuance to allow for last-time buys and spares replenishment.





### **4.3 Spare Equipment**

- A. The Contractor shall supply all spare equipment in new condition.
- B. The Contractor shall include recommended initial spare parts and test equipment to be procured as part of the initial contract. The District is required to maintain the necessary spares on hand to repair the LMR systems to provide timely restoration of the system.
- C. 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 District maintenance activities
- D. Initial spares for less critical items shall also be enumerated
- E. 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).
- F. The Contractor shall determine the types and quantities of spares based on their proposed system size and design.
- G. The 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).
- H. Test Equipment: The Contractor shall provide and price a list of recommended test equipment and applications.





#### **4.4 Lifecycle Support**

- A. Any Contractor-supplied products (including 3<sup>rd</sup> party equipment) shall not be accepted with components or modules at the end of their respective lifecycles.
- B. The 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 7 years shall be considered "end of lifecycle" products.
- D. The Contractor shall provide spare parts and equipment at a discounted rate for the life of the contract.
- E. The Contractor shall provide technical support at a discounted rate for the life of the contract.
- F. The Contractor shall provide engineering services at a discounted rate for the life of the contract.

#### **4.5 Post-Warranty Support**

- A. The Contractor shall offer the OPTION to purchase extended warranty for all supplied equipment. It is the District's desire to self-maintain the system, after the warranty has expired.
- B. The Contractor shall offer the OPTION to purchase any of the following post-warranty service(s) for all supplied equipment:
  - 1. Remote technical support
  - 2. Software support and upgrades
  - 3. Onsite support and repair
- C. The Contractor shall offer these OPTIONAL extended warranty and post-warranty services in annual increments following expiration of the 3-year warranty (years 4-15).
- D. The Contractor shall provide discounted software support and upgrades for the system.





## Appendix A – Shape Files for Coverage Modeling

Refer to *Appendix A – Shape Files.pdf*, provided as a separate electronic file.





## Appendix B – Sun Wireless Study

Refer to *SunWireless Public Safety Radio and Microwave System Backhaul Study for Heartland Communications\_012323 (1).pdf*, provided as a separate electronic file.







## Appendix C – VHF Gap Analysis

Refer to *VHF GAP Analysis San Diego MAIN\_A. (1).pdf*, provided as a separate electronic file.

