North County Dispatch
Joint Powers Authority

Request for Proposals

Public Safety Voice Radio Communications System

Functional Specifications

DUE: May 27, 2022 by 5:00pm

Prepared by

Federal Engineering, Inc.
10600 Arrowhead Dr., Suite 160
Fairfax, VA 22030
703-359-8200

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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 “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

1.1.1 General

A. Refer to the Proposal Requirements section of this RFP for a description of the existing North County Dispatch Joint Powers Authority (NCDJPA), representing the North Mutual Aid Zone (North Zone) of San Diego County, VHF analog conventional land mobile radio (LMR) system for mutual aid communications between local, State and Federal fire agencies during wildland fire and all-hazard incident response.

B. The NCDJPA is seeking a Contractor to upgrade and expand their VHF LMR system to support mission critical communications in the North Zone. The VHF P25 Capable system upgrade/expansion must provide basic, two-way wireless communications capabilities to all radio users and must include:

   1. New VHF analog conventional repeaters for enhanced radio coverage in the North Zone.

   2. New licensed 900 MHz Ethernet or IP-based “last-mile” links to connect VHF repeaters to existing San Diego Regional Communications System (RCS) microwave backhaul sites.

C. The VHF conventional repeaters must be installed at sites in San Diego County North Mutual Aid Zone Area for the NCDJPA as described in Section 1.1.2.

D. The system must provide mobile and on-street portable radio coverage throughout the North Mutual Aid Zone.

E. The Contractor must perform all installation, testing and cutover work in a way that allows the NCDJPA to maintain communications on the existing radio systems to support wildland fire and all-hazard incident response.

1.1.2 NCDJPA Sites

A. Table 1 shows how all North Zone channels are currently being used and how they will be used with the upgraded system.

Table 1 – North Zone XSD Channels

Channels	Current Use	Future
XSD CMD 5	Zone wide dispatch	Entire North Zone
XSD CMD 6	West Area of North Zone	West area of North Zone
XSD CMD 7	Central Area of North Zone	Central area of North Zone
XSD CMD 8	Central area of North Zone	Central area of North Zone
XSD CMD 13	Escondido Fire Area	Escondido
XSD CMD 16	East Area of North Zone	East area of North Zone
XSD CMD 21	Mutual Threat Zone on Camp Pendleton	West area and Entire North Zone

B. The XSD CMD 5, 6, 7 and 8 channels in the North Zone must be equipped with VHF analog conventional repeaters at the sites in Table 2.

Table 2 – North Zone XSD CMD Channel Sites – CMD 5, 6, 7 and 8

XSD Channels			
CMD 5	**CMD 6**	**CMD 7**	**CMD 8**
Black Mountain	Black Mountain	Black Mountain	Black Mountain
Buffalo Bump	Buffalo Bump	Boucher Hill	Boucher Hill
Fire Mountain	Lake San Marcos Peak	Fire Mountain	Fire Mountain
Harmony Hill	San Onofre Mountain	Harmony Hill	Harmony Hill
Lake San Marcos Peak		Lake San Marcos Peak	Hubbard Hill
Pala RCS		Pala RCS	Lake San Marcos Peak
Palomar Mountain (Co.)		Palomar Mountain (Co.)	Mt. Woodson
Red Mountain (State or ATC Site)		Palomar Mountain (private)[1]	Pala RCS
San Onofre Mountain		Rainbow Peak	Palomar Mountain (Co.)
Sierra Rojo		Red Mountain (State or ATC Site)	Rainbow Peak
			Red Mountain (State or ATC Site)

1. The NCDJPA has an existing repeater at the Palomar Mountain (private) site on the XSD CMD 7 channel that will need to be replaced

C. The XSD CMD 13, 16 and 21 channels in the North Zone must be equipped with VHF analog conventional repeaters at the sites in Table 3.

Table 3 – North Zone XSD CMD Channel Sites – CMD 13, 16 and 21

XSD Channels		
CMD 13	**CMD 16**	**CMD 21**
Boucher Hill	Big Black Mountain	Black Mountain
Harmony Hill	Boucher Hill	Buffalo Bump
Mt. Woodson(City of SD Lower Site)	Mt. Woodson (City of SD Lower Site)	Fire Mountain
	Pala RCS	Harmony Hill
	Rainbow Peak	Lake San Marcos Peak Mt. Woodson (City of SD Lower Site)
	Sierra Rojo	Pala RCS
	Valley Center Water Tank	Palomar Mountain (Co.)
		Red Mountain (State or ATC Site)
		San Onofre Mountain

1. The NCDJPA has existing repeaters at the Fallbrook/Minnesota site on the XSD CMD 5 and XSD CMD 21 channels that will not be part of the new

system but will be used by the NCDJPA as a backup site, as needed, and will need backhaul connection.

D. The Contractor must furnish and install new P25 Capable VHF analog conventional repeaters for the XSD CMD 5, 6, 7, 8, 13, 16 and 21 channels at the sites and on the frequencies listed below. The transmit CTCSS tones must be the same for all repeaters on a channel and the receive CTCSS tones for each repeater must be unique so that a radio user cannot “key up” multiple repeaters simultaneously. The Contractor must work with the NCDJPA to identify transmit and receive CTCSS tones for each channel/repeater.

1. XSD CMD 5

   a. Black Mountain, Buffalo Bump, Fire Mountain, Harmony Hill, Lake San Marcos Peak, Pala RCS, Palomar Mountain County Site (replace EOL repeater), Red Mountain (State or Private ATC), San Onofre Mountain, and Sierra Rojo.

   b. 153.89 MHz Tx/150.805 MHz Rx

2. XSD CMD 6

   a. Black Mountain, Buffalo Bump, Lake San Marcos Peak, and San Onofre Mountain

   b. 154.025 MHz Tx/158.745 MHz Rx

3. XSD CMD 7

   a. Black Mountain, Boucher Hill, Fire Mountain, Harmony Hill, Lake San Marcos Peak, Pala RCS, Palomar Mt. County (add repeater), Palomar Mountain (Private) (replace EOL repeater), Rainbow Peak, and Red Moutain State or PVT

   b. 154.235 MHz Tx/158.985 MHz Rx

4. XSD CMD 8

   a. Black Mountain, Boucher Hill, Fire Mountian, Harmony Hill, Hubbard Hill, Lake San Marcos Peak, Mt. Woodson, Pala RCS, Palomar Mt. County site, Rainbow Peak, Red Mountain (State or Private)

5. b. 155.685 MHz Tx/158.805 MHz RxXSD CMD 13

a. Boucher Hill, Harmony Hill and Mt. Woodson (City of San Diego Lower Site)

b. 155.1 MHz Tx/158.88 MHz Rx

6. XSD CMD 16

a. Big Black Mountain, Boucher Hill, Mt. Woodson (City of San Diego Lower Site) , Pala RCS, Rainbow Peak, Sierra Rojo, Valley Center Water Tank

b. 155.775 MHz Tx/158.910 MHz Rx (TBD)

7. XSD CMD 21

a. Black Mountain, Buffalo Bump, Fire Mountain, Harmmony Hill, Lake San Marcos Peak, Mt. Woodson, Pala RCS, Palomar Mountain (Co.), Red Mountain (State or Private), and San Onofre Mountain

b. 153.815 MHz Tx/151.1 MHz Rx

E. Microwave Backhaul

1. All VHF analog conventional repeaters for the XSD CMD 5, 6, 7, 8, 13, 16 and 21 channels must be connected to an existing RCS microwave backhaul site. The sites in Table 4 are currently connected to the RCS microwave backhaul system, therefore, the Contractor does not need to provide new microwave links to these sites but will need to ensure connectivity for any spur link requirements.

Table 4 – North Zone Sites on the RCS Backhaul

RCS Site
Black Mountain
Boucher Hill
Ellery
Harmony Hill
Hubbard Hill
Lake San Marcos Peak
Mt. Woodson
Pala
Palomar Mountain (County Site)
Rainbow Peak
Red Mountain (State)
San Marcos Mountain
Sierra Rojo

2. The Contractor must furnish and install the following licensed 900 MHz spur links:

   a. Buffalo Bump to Red Mountain (State)

   b. Del Mar to Lake San Marcos Peak

   c. Oak Crest Reservoir/Encinitas to Lake San Marcos Peak

   d. Morro Hills to Red Mountain (State)

   e. San Onofre Mountain to Red Mountain (State)

   f. Fire Mountain to San Marcos Mountain (other options: Red Mountain State or Ellery or San Onfore)

   g. Big Black Mountain to Volcan North

   h. Mt. Woodson City Site to Mt. Woodson County Site (ATC)

   i. Valley Center Water Tank to Sierra Rojo

   j. Palomar PVT Site to Valley Center Water Tank (other options: Palomar County or Pala sites)

   k. Fallbrook Minnesota Site to Valley Center Water Tank

l. Red Mountain PVT site to Red Mountain (State)

3. The spur links listed above were identified using microwave path design software to verify adequate clearance above terrain and obstructions, however, site and physical path surveys were not conducted. The Contractor must conduct site and physical path surveys and validate that each of the links listed above will meet the following specifications:

   a. Minimum capacity of 64 Kbps for each VHF repeater (i.e. 128 Kbps for two repeaters, 192 Kbps for three repeaters, etc.)

   a. Minimum two-way availability of 99.999%

4. If any of the links will not meet the minimum capacity and availability specifications, the Contractor must identify an alternate path to another RCS microwave backhaul site that will.

5. All links must be unprotected spurs and use Ethernet/IP-based technology

6. If the same link is used to connect VHF repeaters to the RCS microwave backhaul system for multiple zones, the Contractor must furnish one link that will meet the capacity needs for all zones.

7. The Contractor must coordinate with the NCDJPA for the connection of new 900 MHz radios at the RCS microwave backhaul sites to existing switch or router.

1.1.3 Radio Site Improvements

A. For the North Zone, the Contractor must be responsible for site improvements as identified in Section 2.2, *Site Improvements*.

1.2 Standards and Guidelines

A. The system must 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 must comply with industry best practices for system installation, grounding, bonding, and transient voltage surge suppression (TVSS).

C. At a minimum, the system must comply with at least one of the following standards:

1. Motorola R56 - Standards and Guidelines for Communication Sites (latest revision)
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

D. In addition to meeting the minimum requirements, the system must 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 must be submitted to the NCDJPA 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 must 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 to the satisfaction of the NCDJPA.

H. If the Contractor cannot meet any of the standards or guidelines, the Contractor must list all deviations in their proposal, for approval by NCDJPA.

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 5 lists DAQ values and definitions.

Table 5 – DAQ Values and Definitions

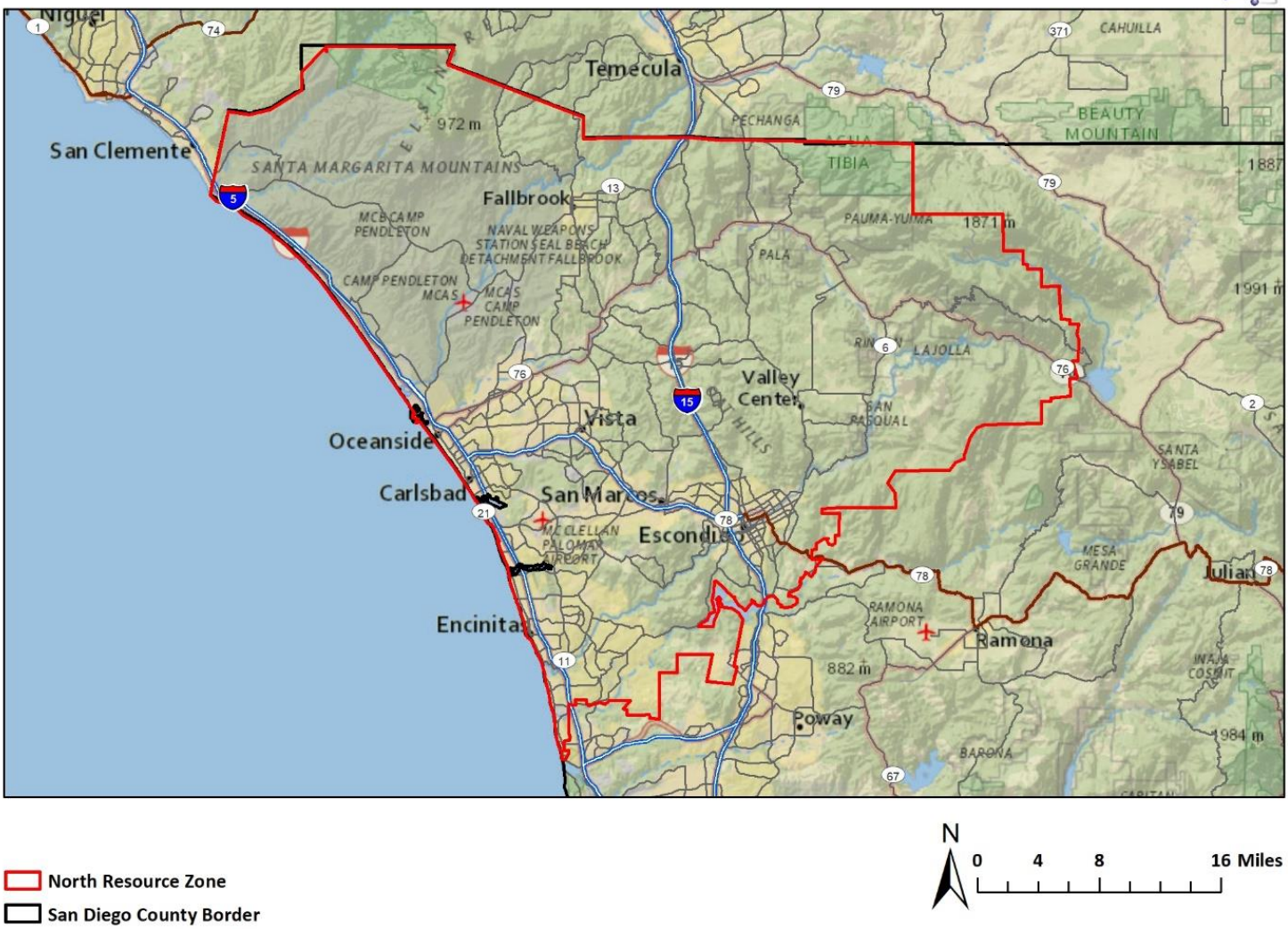
DAQ	Subjective Performance Description
1	Unusable, Speech Present, but unreadable
2	Understandable with considerable effort. Frequent repetition due to noise/distortion
3	Speech understandable with slight effort. Occasional repetition required due to noise/distortion
3.4	Speech understandable with repetition 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 must adhere to TIA Telecommunications Systems Bulletin (TSB)-88: Wireless Communications Systems Performance in Noise and Interference-Limited Situations, current version.

C. The Contractor must complete coverage testing with witnesses from the NCDJPA, utilizing non-automated subjective DAQ testing for each XSD CMD channel.

1.3.2 North Zone Requirements

San Diego County VHF North Zone



A. The VHF radio system upgrade must serve the geographical boundaries of the North Zone as shown in Figure 1 (shown in red).

Figure 1 – North Zone Service Area

B. The Contractor must perform composite mobile and on-street portable coverage analyses (talk-out and talk-in) for each channel in the North Zone using the sites and site parameters in Table 6 to show what areas can be covered. After system installation, the Contractor will be required to perform coverage testing to confirm specified coverage. Refer to Section 3.10, *Coverage Testing*.

C. The Contractor must specify the guaranteed talk-in and talk-out coverage that the 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 must be the composite of all repeaters on a channel.

1. For existing NCDJPA repeaters, the radio output power, and Effective Radiated Power (ERP) levels and antenna height and gain must be the maximum as permitted by FCC rules and regulations and the NCDJPA's FCC licenses.

2. For new sites, the Contractor must assume 100 watts ERP.

Table 6 – North Zone Radio Site Parameters

		Coordinates		Antenna	
Site	XSD CMD Channel	Latitude	Longitude	TX Antenna Height (ft)	RX Antenna Height (ft)
Big Black Mountain	16	33.15992	-116.80806	45	45
Black Mountain	5,6,7,8,21	32.98141	-117.11647	62	62
Boucher Hill	7,8,13,16	33.33464	-116.91936	95	125
Buffalo Bump	5,6,21	33.42826	-117.38247	100	100
Del Mar	5,6,21	32.95286	-117.25681	32	32
Ellery	5,6,21	33.16502	-117.32233	70	70
Fallbrook	5, 21	33.40031	-117.19086	103	103
Fire Mountain	5, 6, 7, 8 ,21	33.19281	-117.33911	40	40
Harmony Hill	5,7,8,13 21	33.09188	-117.14328	65	65
Hubbard Hill	7,8,13,16 21	33.15224	-117.07853	60 / 80	60 / 80
Lake San Marcos Peak	5,6,7,8,21	33.11129	-117.20225	50	50
Morro Hills	5,6, 11 or 7, 21	33.29496	-117.27190	45	45
Mt. Woodson	8, 13,16, 21	33.00909	-116.97262	100	100
Oak Crest Reservoir	5,6,21	33.04390	-117.26598	40	40
Pala RCS	5,7,8,16 21	33.36586	-117.10616	80	100
Palomar Mountain (Co.)	5,7,8 21	33.31947	-116.88281	40	40
Palomar PVT	7	33.22.18.42 N	-116.56.50 W	60	60

Site	XSD CMD Channel	Coordinates		Antenna	
		Latitude	Longitude	TX Antenna Height (ft)	RX Antenna Height (ft)
Rainbow Peak	7,8,16	33.40747	-117.12788	46	46
Red Mountain (State or ATC)[1]	5,7,8, 21	33.40080	-117.19051	72	72
San Marcos Mountain	5,7,8, 21	33.21424	-117.18760	187	187
San Onofre Mountain	5,6,21	33.36220	-117.49606	180 / 200	180 / 200
Sierra Rojo	5,16	33.24695	-117.07892	60	80
Valley Center Water Tank	16	33.29519	-117.04602	60	60

1.3.3 Coverage Analysis

A. Coverage analyses must adhere to the following specifications for determining the proposed system's ability to meet individual channel coverage requirements. All coverage analyses and maps must be developed using these 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

   a. 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 must accommodate vehicles at speeds up to 75 mph

3. Required reliability within the guaranteed coverage area for each XSD CMD channel is 95%

1.3.4 Coverage Maps

A. The Contractor must provide a detailed description of the propagation models used and the assumptions made in preparation of the coverage maps.

[1] The County currently has a CMD 7 repeater at the American Tower site on Red Mountain (about 200' from the State site) but would like to move to the State site.

B. The Contractor must 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 must 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 must 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 must 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 must be provided in two formats:

1. 8.5"x11" (minimum) full color hardcopy format

2. In PDF file format with sufficient resolution to discern roadways and similar detail.

G. All maps must include a background layer suitable for the NCDJPA's reference (e.g., topographic map, roads, and rivers).

H. Link budgets must be provided, clearly defining the following minimum information, relating to each map and each site:

1. Propagation model

2. Design target

3. Vendor-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 mutlicoupler 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 must 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 must supply new 12-port Ethernet switches.

C. All Contractor supplied equipment must have monitor/alarm interfaces to provide status to a Network Management System via Ethernet/IP-based connection to include all NCDJPA sites.

D. All Contractor supplied equipment must be equipped for 120 VAC power.

1.4.2 Conventional Repeaters

A. Conventional repeaters must:

1. Operate in the VHF frequency band (136 – 174 MHz) in conventional analog mode but must 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 must include all 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 must be appropriate given the radio band and required length, to provide the required coverage

b. Transmission line length must 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 must supply and install a new VHF transmit combiner and receive multi-coupler system at sites that will have multiple channels.

C. The Contractor must fully describe expansion capacity for new combiner and multi-coupler systems.

D. Antenna systems must:

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 must be selected to perform in and endure the anticipated environmental conditions. High elevation mountain, desert, high wind and/or salt air locations must be considered.

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

G. Some existing NCDJPA repeaters are licensed for and use directional and/or down tilt transmit antennas. The Contractor must not alter the existing antenna's radiation pattern without the NCDJPA's prior written concurrence.

1.5 Licensed 900 MHz Microwave Links

This section describes the general, functional, and operational requirements of the desired licensed 900 MHz microwave links to connect VHF repeater sites to the existing RCS microwave backhaul system.

1.5.1 Link Requirements

A. The Contractor must 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.

B. The 900 MHz microwave radio links must:

1. Support both Ethernet/IP-based and TDM traffic.

2. Be non-protected (1+0)

3. Utilize components that have been fully tested in the field, having a proven service history of over 3 years

C. Manufacturers that supply components for the system must have a proven and known supply chain to serve the NCDJPA for the lifecycle of the network.

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

E. All licensed 900 MHz microwave links must be designed for a minimum two-way end-to-end annual availability of 99.999% at a maximum BER of 10^{-6}, at the capacities specified in Sections 1.1.2.E and 1.5.2.A.6.

1.5.2 Licensed 900 MHz Microwave Radios

A. All licensed 900 MHz microwave radios must:

1. Be 19” rack mountable

2. Be type accepted for licensing under Part 101 of the FCC Rules and Regulations

3. Support built-in error detection and correction

4. Be configured initially for non-protected (1+0) operation, but support non-protected (1+0), hot standby (HSB) and space diversity (SD) configurations

5. Frequency range – 928 – 960 MHz

6. Support a minimum link capacity of 500 Kbps

7. Support QPSK/16 QAM/64 QAM modulation levels

8. Support Ethernet and TDM (DS0/DS1) interfaces

9. Support an operating temperature of – 10°C to +50° C

10. Be equipped for 120 VAC power

11. Support Simple Network Management Protocol (SNMP) for remote monitoring via common network management tools

12. Provide sufficient transmit output power to meet the requirements of each link, and comply with frequency coordination limitations and applicable FCC rules

1.5.3 Licensed 900 MHz Microwave Radio Antennas

A. 900 MHz microwave radio antennas must:

1. Be, compatible with the licensed 900 MHz radio frequency band and conform to applicable FCC requirements

2. Be panel or yagi type with sufficient gain to meet the specified path availability requirements

3. Minimum gain: 10 dBd

4. Impedance: 50 ohms

5. VSWR: less than 1.5:1

6. Minimum front/back Ratio: 20 dB

7. Survival wind speed – 120 mph

1.5.4 Grounding and Lightning Protection

A. The Contractor must furnish and install grounding and lightning protection equipment for all licensed 900 MHz microwave radios, to include, but not limited to, the following:

1. Lightning arrestors

2. Feedline ground kits at a minimum of three locations: 1) just below the antenna, 2) at the base of the tower just above the horizontal run to the shelter and 3) outside the shelter before entering the building.

1.5.5 Maintenance Software

A. The Contractor may supply proprietary software for the 900 MHz radios, to be installed on NCDJPA-provided laptops, to allow NCDJPA technicians to perform on-site configuration, maintenance, and troubleshooting.

B. The Contractor must provide specific hardware and operating system specifications which are required to operate the maintenance software.

2. Site Improvements

2.1 General Requirements

A. The Contractor must be responsible for all site improvements described in this section and deficiencies discovered through the Contractor site surveys. Table 7 shows the site improvements required . A “Y” (yes) in the table under the items in red identifies site improvements that the Contractor is responsible for.

B. The Contractor must perform structural analyses on all existing towers identified in Table 7. If no current drawings are available, the Contractor must map the tower mapping as required for the structural analysis.

1. Structural analysis must be performed on existing towers according to the ANSI/TIA-222 standard, latest version applicable at time of structural analysis

2. Structural analysis must include existing and proposed equipment; however, it is the NCDJPA’s intent that the Contractor remove unused system equipment upon system acceptance

3. Structural analysis reports must be provided to the NCDJPA upon completion

4. If a tower fails the structural analysis, the Contractor must consult with the NCDJPA to determine how to proceed.

C. The Contractor must perform site grounding upgrades for those sites identified in Table 7 to be compliant with their selected grounding and lightning protection standards.

D. The Contractor must identify and propose any additional work necessary to make radio sites and infrastructure usable for the new LMR system and microwave backhaul. The Contractor must consult with the NCDJPA to determine how to proceed with site improvements identified during the site surveys that are not identified in this section.

E. The Contractor must complete any documents required by local, state, and federal departments including, but not limited to permitting documents and State Historic Preservation Office (SHPO) forms.

F. Code Compliance:

1. Installation of all electrical equipment, power distribution, lighting assemblies and associated wiring must comply with the most recent edition of the National Electric Code (NEC) and Occupational Safety and Health Administration (OSHA) regulations

2. All electrical equipment must be listed or approved by Underwriters Laboratories (UL)

3. The Contractor and their subcontractor(s) must comply with all applicable local codes as well as industry best practices and guidelines stipulated in Section 1. 2, *Standards and Guidelines*

G. The Contractor must 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

H. The Contractor must coordinate with utility companies for all utility related items, such as electrical service hookups and disconnects.

I. The Contractor must furnish and install outdoor cabinets as identified in Table 7. The Contractor must furnish and install equipment racks for all other sites.

Table 7 – North Zone Site Improvements

North Zone	Tower					Shelter					Power			
Site Name	Existing Structure with Available Space	Structural Analysis	Existing Tower Mods	New Tower Structure	A&E, Environmental Compliance	Existing Shelter/Bldg. with Available Space	Site Grounding Updates	Existing Shelter HVAC Upgrade(s) Needed	New Prefab Shelter	New Outdoor Cabinet	Commercial AC Power Available	New Generator	New Rackmount UPS	New DC System
Big Black Mountain														
Black Mountain	Y	Y				Y					Y			
Boucher Hill	Y	Y				Y					Y			
Buffalo Bump	Y	Y				Y					Y			
Del Mar	Y	Y		Y	Y	Y	Y	Y			Y		Y	
Ellery	Y					Y					Y			
Oak Crest Reservoir	Y			Y	Y	Y	Y				Y	Y		
Fallbrook	Y					Y	Y	Y			Y	Y		
Fire Mountain[2]	Y		Y			Y					Y			
Harmony Hill	Y	Y				Y					Y			
Hubbard Hill	Y	Y				Y					Y			
Lake San Marcos Peak	Y	Y				Y					Y			
Morro Hills	Y	Y		Y		Y			Y		Y	Y	Y	
Mt. Woodson	Y	Y				Y					Y			
Pala RCS	Y					Y					Y		Y	
Palomar Mountain (County)	Y					Y					Y			
Palomar Mountain (Private)														
Rainbow Peak	Y	Y				Y					Y			
Red Mountain (State or ATC)	Y	Y		Y		Y	Y		Y		Y	Y		
San Marcos Mountain	Y					Y					Y			
San Onofre Mountain	Y	Y				Y					Y			
Sierra Rojo	Y	Y				Y					Y			
Valley Center Water Tank														
Microwave-Only Sites														
Volcan North	Y	Y				Y					Y			

[2] Site development is in progress, so structural analysis and site upgrades do not need to be included in the cost estimate.

2.2 Equipment Enclosures

2.2.1 Equipment Racks

A. The Contractor must 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 must support no less than a 1,000-pound equipment load
8. New equipment racks must be furnished with an A/B fuse distribution panel capable of distributing -48 VDC to all equipment in the rack. The fuse panel must be furnished with a blown fuse alarm for remote monitoring

2.2.2 Outdoor Cabinets

A. The Contractor must provide outdoor communications equipment cabinets that meets the following minimum requirements:

1. Support all LMR and 900 MHz radios and associated equipment at a site
2. Height – 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 must be spaced vertically to provide 1.75-inch units.

2.3 Equipment Shelter

2.3.1 General

A. The Selected Vendor may recommend re-use of existing shelters based on space availability and/or the ability to meet system requirements, as discovered through the mandatory site surveys. The NCDJPA must approve re-use of existing shelter(s).

B. If required, the Selected Vendor must supply a new equipment shelter for existing sites.

C. The Selected Vendor must supply a new equipment shelter for all new sites.

D. Should a new equipment shelter be required at any site in the Selected Vendor's design, it must comply with the requirements of this section.

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

F. For all sites where an existing equipment room is not sufficient to accommodate the new radio equipment in accordance with current industry site standards, the Selected Vendor must provide new equipment shelters. The Selected Vendor must describe where new equipment shelters are included in their design.

2.3.2 Shelter Size

A. The minimum exterior shelter dimensions must be 12’ x 16’. Minimum interior height must be 9’, unless waived by the NCDJPA.

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

2.3.3 Shelter Design and Construction Requirements

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

1. If any site will not accommodate a prefabricated shelter, the NCDJPA will consider site assembly and other shelter types.

2. The Selected Vendor is responsible for all costs, permits and approvals required to transport the shelter to the site and for assembling and constructing the shelter at the site.

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

1. 200 pounds per square foot distributed floor loading while on foundation

2. 125 pounds per square foot distributed floor loading while lifting

3. 200 pounds per square foot minimum roof load and a concentrated load of at least 500 pounds per square foot

4. Minimum wind requirements as specified in San Diego County zone in TIA 222 Standard current revision

5. Seismic Design Category [D]

6. Vents and entryways must be constructed to deter vandalism

7. Vents and entryways must be constructed to prevent entry of rodents

8. Waterproof

2.3.4 Exterior Finish

The exterior finish of the shelter must be exposed aggregate.

2.3.5 Bullet Resistance

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

2.3.6 Fire Rating

Shelter walls must provide a two-hour fire rating.

2.3.7 Insulation and Interior Finish

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

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

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

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

2.3.8 Exterior Door

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

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

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

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

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

2.3.9 Power Distribution

Power distribution must include the following:

A. One MOV/SAD only lightning arrestor, Type 1.

B. One MOV lightning arrestor, Type 2.

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

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

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

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

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

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

I. Six 20 Amp specification grade duplex receptacles.

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

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

L. All wiring must be installed in surface mounted conduit or NEMA wire ways and be in full compliance with ANSI/NFPA-70 - The National Electric Code, latest version.

2.3.10 Lighting

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

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

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

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

E. Light fixtures must employ earthquake bracing.

F. Interior lighting control switches must be located near the non-hinged side of the entrance door to the equipment shelter. One switch must control a single lighting fixture and the second switch must control the remaining lighting fixtures. Refer to NFPA, NEC 70-2011 (or latest edition) Article 410 - Luminaries, Lamp Holders, and Lamps for additional information.

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

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

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

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

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

2.3.11 HVAC

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

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

1. Redundant lead/lag controls allowing approximately equal operating time on each air conditioning unit
2. Active dehumidification controls that modulate heat and air conditioning operation to control high humidity conditions
3. One 650 cfm at 0" of H2O static pressure exhaust fan system, including motorized intake and exhaust louvers, thermostat, fiberglass hoods, permanent expanded metal dust filter and exhaust insect screen

2.3.12 Site Alarms

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

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

1. Surge arrestors
2. Transfer switch (normal or bypass state)
3. Power fail
4. HVAC
5. Smoke detector
6. Intrusion detection
7. High temperature
8. Low temperature
9. High humidity
10. UPS/DC Power Plant fail

11. UPS state (normal or bypass)
12. Generator (including, e.g., generator run, low fuel, high temp, and fail)
13. Generator not in auto
14. Propane fuel level low
15. Tower lighting alarms
16. To reduce false alarms, all alarm contacts must be normally closed when no alarm is present.

2.3.13 Grounding

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

D. The required impedance of the ground system is 5-Ohms or less.

2.3.14 Drawings

The Selected Vendor must:

A. Provide three sets of shelter drawings with each shelter.

B. Supply typical foundation drawings based on Presumptive Soil Parameters specified in the TIA -222 Standard current revision.

C. Validate all foundation design parameters and assumptions for the specific site prior to construction.

D. Supply support calculations for recommended building tie down locations.

2.3.15 Generator Plug

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

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

2.4 Site Generator

2.4.1 General

A. If required, the Selected Vendor must supply a new site generator for new and/or existing sites.

B. The Selected Vendor must supply a new site generator for existing sites based on deficiencies discovered through their site surveys.

C. The Selected Vendor must supply and install new generators that comply with the Outdoor-Use Units specifications in UL 2200, latest edition.

D. The Selected Vendor may recommend reuse of existing generators based on the site survey findings. The NCDJPA must approve reuse of any existing site generators.

2.4.2 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

2.4.3 Enclosure

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

2.4.4 Muffler Type

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

2.4.5 Control Panel

A. The generator control panel must 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 must 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"

2.4.6 Miscellaneous

A. Generator will be supplied with block heater, 10 Amp battery charger, and meet NFPA99 and 110 requirements.

B. Fuel tanks must be sized to accommodate for a 7-day run time with a minimum size of 500 gallons.

C. The Selected Vendor must be responsible for generator installation, test, and first fill of all fuel tanks.

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

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

2.4.7 Automatic Transfer Switch (ATS)

A. The Selected Vendor must install the ATS in the shelter prior to shelter shipment.

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

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

2.5 Self-Supporting / Monopole Tower

2.5.1 General

A. The Selected Vendor must leverage existing building rooftop structures to the extent possible.

B. The Selected Vendor must supply and install the necessary hardware to mount the new antenna systems at the proposed sites and heights.

C. If required, the Selected Vendor must supply a new self-supporting tower for new and/or existing sites.

D. The Selected Vendor may recommend reuse of existing towers based on the site survey findings and structural analysis results. The NCDJPA must approve reuse of any existing tower structure.

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

2.5.2 Design Criteria

A. The design must 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 must be designed for all equipment, appurtenances, ancillary equipment, antenna loading and include 25% future capacity.

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

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

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

2. Bolts must 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 must be clearly labeled at the base of the tower. Labeling must be weatherproof and durable such as a stamped metal plate or equivalent.

2.5.3 Waveguide Support

A. There must 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 must comply with tower and cable manufacturer's installation specifications.

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

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

E. The support system must 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 must be designed to meet rigidity specifications similar to the tower.

2.5.4 Waveguide Bridge

The tower must 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 must be posts placed on both lateral sides of the bridge to fully support the load.

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

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

D. The Selected Vendor must furnish and install the waveguide bridge between the tower and equipment shelter.

E. The following criteria must 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 must be fabricated from galvanized bar grating or approved equivalent
6. All components of the waveguide bridge must be hot-dipped galvanized after fabrication
7. Posts must have galvanized caps
8. Posts must be set in concrete foundations.

9. Each post must be separately grounded to the site ground system with 1/0 AWG stranded bare copper conductor

10. Waveguide bridge must be adjustable in height to allow interface with shelter waveguide entry ports

11. Waveguide Bridge must be effectively grounded to the external ground bar

2.5.5 Climbing Equipment

A. The tower must 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 must be a climbing safety system compliant to original manufacturer's specifications.

C. The equipment must comply with TIA-222 current revision.

2.6 Power Systems

2.6.1 DC Power Requirements

A. The proposal must include new DC power systems for all sites where new equipment is being proposed.

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

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

F. The power supply/charger must 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 must be accomplished within eight hours

8. Output noise must not degrade the performance of LMR and microwave radio equipment in the vicinity of the power supply/charger

9. AC to DC conversion efficiency must not be less than 75%

10. Must include equalize circuitry and controls for periodic manual equalization of batteries as needed

11. Must be 19-inch rack mountable

12. Must be equipped with an input power AC circuit breaker, output power DC circuit breaker, DC current meter and DC voltage meter

13. Must be initially configured for independent operation, however, must be capable of operating in parallel with another power supply/charger in the future, without damage to either unit

14. Must provide separate adjustable voltages for floating and equalizing of the batteries, with the voltages initially adjusted to accommodate the batteries provided

15. Must include short circuit current protection and high voltage shutdown circuitry

16. Each alarm must include a Form “C” contact for connection to an external alarm, and the alarm status must be displayed on the front panel of the power supply/charger

G. The 48-volt batteries must:

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 must:

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 must be activated if any breaker trips or is shut off

d. Be 19-inch rack mountable

2. Circuit breaker panels must:

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 must:

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 must 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 must 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

2.6.2 Uninterruptible Power Supply Requirements

A. The proposal must include a new Uninterruptible Power Supply (UPS) for all sites where new equipment is being proposed.

B. The UPS must 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 must be connected to a dedicated subpanel feeding quad 20A twist lock outlets to be installed on the overhead cable tray

C. 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 must 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 must be accessible on a common control panel on the front of the UPS enclosure.

D. 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. Two-hour battery operation

3. System Implementation, Test and Acceptance

3.1 Project Management

A. The Contractor must attend project and construction meetings as deemed necessary by the NCDJPA prior to and during installation. Additional meetings may be scheduled at the discretion of the NCDJPA.

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

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

3.1.1 Project Staffing

A. The Contractor must 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 must serve for the duration of the project unless the Contractor proposes an alternative plan to the NCDJPA for consideration and gains approval.

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

D. The Contractor Project Manager

1. The Project Manager must be the primary point of contact between the NCDJPA and the Contractor.

2. The Project Manager must bear full responsibility for supervising and coordinating the installation and deployment of the communications system.

3. The Project Manager must 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 must be responsible for coordinating and facilitating weekly status meetings.

E. The Contractor's Systems Engineer

1. The Systems Engineer must 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 must be subject to project change control procedures and will not be undertaken until approved by the NCDJPA.

3. The Systems Engineer must ensure the accurate development of block diagrams, system-level diagrams, and rack diagrams.

4. The project engineer must supervise the development and execution of:

   a. Acceptance Test Plan (ATP)

   b. Coverage Acceptance Test Plan (CATP)

5. The Systems Engineer must guide the project team through the processes and procedures necessary to prove that the system performs as specified in the contract.

6. The NCDJPA must approve all test plans prior to execution.

3.1.2 Scheduling

A. The Contractor’s Project Manager must 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 must represent tasks associated with completing work on all items identified in the WBS.

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

D. The Contractor must present all schedule updates to the NCDJPA during the weekly status meetings.

E. The schedule must 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 North Zone-NCDJPA
13. Field Acceptance Testing North Zone-NCDJPA
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 must schedule a project kickoff meeting prior to beginning project work.

B. The Contractor must schedule weekly project status meetings following contract award and the project kickoff meeting.

C. Weekly status meetings must continue through the duration of the project until the NCDJPA issues final system acceptance.

D. The Contractor must be responsible for facilitating the weekly status meetings

E. The Contractor must prepare and distribute meeting agendas to the NCDJPA 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 must 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 must submit a project quality assurance (QA)/quality control (QC) plan for NCDJPA with the County review during preliminary design as described in this section.

B. The QA/QC plan must 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 must:

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 NCDJPA personnel as part of the review and approval process for all deliverables and submittals.

5. The proposed QA/QC plan must 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 NCDJPA.

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

C. The Contractor must maintain the punch list in real time.

D. The Contractor must distribute the punch list to the NCDJPA weekly via e-mail.

E. The punch list must 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 NCDJPA to transfer the responsibility of an item to another person or group, the Contractor must add a new entry to the punch list and appropriately note the original entry.

G. The Contractor must be responsible for reviewing each punch list item and advising the NCDJPA of any changes.

H. The Contractor must update the status of punch list items during each weekly status meeting.

3.1.6 Background Checks

A. The Contractor may be required to authorize the investigation of its personnel, subcontractors, independent contractors, Subject Matter Experts (SMEs), etc., that must have access to non-public areas of the NCDJPA's facilities, radio systems, network, data, or other sensitive information.

B. The scope of the background check is at the discretion of the NCDJPA. The cost of attending the background investigation must be the responsibility of the Contractor.

3.2 Site Surveys

A. The Contractor must participate in a mandatory site survey with the NCDJPA to confirm actual equipment location within each space prior to the start of the system installation.

B. During the mandatory site survey, the Contractor must determine and document any changes needed to the detailed design installation drawings. All detailed design drawings and documents requiring changes must be revised prior to installation and reviewed by the NCDJPA.

C. The Contractor must 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 NCDJPA equipment that can be reused on the new system

D. The Contractor must 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.jpg”) of:
    a. Overall site, showing location of radio tower(s) and equipment shelter(s)
    b. The radio tower(s)

c. Antennas to be used for this project or location for new antennas

d. Radio shelter exterior

e. Inside of equipment shelter, including front and rear of existing radio equipment to be removed

f. Coaxial cable and waveguide routes

g. Rack location and position(s) where new equipment will be installed

h. DC panel indicating breakers to be used

i. Dehydrator unit and distribution manifold

j. Feedline entry (inside and outside of shelter)

k. Grounding and lightning protection systems

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

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

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

5. A list of existing equipment that can be reused for the 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 must produce a Grounding Assessment report for each site, based on the standard(s) selected in Section 1.2. The report must 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 must 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 must 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 must submit a Detailed Design package within 60 days after contract award, which must 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 must successfully complete all tests and training prior to the actual cutover of systems.
    c. The Contractor must provide the necessary labor to cutover from existing systems to the proposed system.
    d. The plan must include the schedule and procedures associated with the transition of each operational user group. The plan must specifically address how the existing users will begin using the new system with minimal operational impact.
    e. The plan must provide detailed component or subsystem cutover plans, and specifically delineate between systems that affect and do not affect ongoing operations.
    f. The NCDJPA 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, NCDJPA and Contractor 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 must 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 must 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, NCDJPA name, 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 NCDJPA

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 must 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 must 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 must be submitted no later than 15 business days before the testing starts and must be approved no later than five business days before the testing starts.

K. Any other items as required or requested by the NCDJPA prior to Detailed Design Review.

L. All items required for detail design must be submitted to the NCDJPA 10 business days prior to the detailed design review meeting.

3.5 Detailed Design Review

A. A detailed design review meeting must be conducted to allow the Contractor to present the system detailed design for review and approval.

B. The design review meeting must be scheduled no sooner than one week after delivery of the Detailed Design Package to the NCDJPA, to allow for review time prior to the meeting.

C. The Contractor must update and resubmit their Detailed Design Package based on review comments from the NCDJPA.

D. The detailed design review must be considered the last step prior to ordering and/or manufacturing of equipment. Upon approval of the detailed design by the NCDJPA, the Contractor may begin the ordering and manufacturing of system equipment. The NCDJPA will 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 NCDJPA currently operates on VHF channels and will provide all current licensing information to the Contractor following contract award.

B. The NCDJPA anticipates remaining on the same frequency band and/or channels for the proposed system.

C. The Contractor must 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.

D. The Contractor must 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 NCDJPA.

E. The Contractor must complete and submit FAA forms for antenna structures.

F. The Contractor must complete all required FCC construction deadline notifications.

G. The Contractor must ensure compliance with the FCC's Maximum Permissible Exposure (MPE) requirements.

H. The Contractor must provide copies of each license to the NCDJPA.

I. The Contractor must track all applications and filings with the selected frequency coordinator and/or the FCC.

J. The Contractor must respond to any questions by the selected frequency coordinator and/or the FCC regarding all applications and filings.

K. The Contractor must 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 must 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 must 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 NCDJPA.

C. Transmitters at each site must 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 must mitigate causal and occupational exposure at locations that exceed MPE standards

1. Fencing, signage, and/or other techniques must be approved in advance by the NCDJPA.

3.7 Staging

A. Each individual assembly or equipment unit must undergo factory testing prior to shipment.

B. The Contractor must submit standard factory test documentation, documenting the tests performed and indicating successful completion of testing to the NCDJPA.

C. System staging:

1. The Contractor must perform complete system staging and testing at a location in the United States.

2. To minimize travel and expenses, the NCDJPA 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 NCDJPA that the radio and microwave systems are ready for shipment and installation.

4. The Contractor must provide all necessary technical personnel, and test equipment to conduct staging tests.

5. All deviations, anomalies, and test failures must be resolved at the Contractor's expense.

6. The Contractor must use an approved staging acceptance test plan (SATP).

7. The Contractor must successfully perform all tests before the NCDJPA witnesses the official SATP.

8. The Contractor and the NCDJPA must jointly execute and date the SATP following completion of all tests.

9. All tests in the SATP must be marked as either pass or fail.

10. The Contractor must document all failed components.

11. The Contractor must correct and retest all failed components.

12. The Contractor must 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 NCDJPA's discretion.

14. The Contractor shall provide the NCDJPA 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 must ship and warehouse all equipment and materials at its own expense. The NCDJPA will not store equipment.

B. The Contractor must be responsible for transporting LMR and backhaul equipment to and from the Contractor’s warehouse(s) and the NCDJPA 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 must 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 NCDJPA must preapprove all subcontractors.

   2. The NCDJPA must preapprove any change in subcontractor or its staff.

C. Installation must consist of a complete tested system to include placement of associated cabling, appropriate system layout, and terminal connections.

D. The Contractor must provide associated power supplies and any other hardware, adapters, and/ or connections to deliver a complete operable system to the NCDJPA.

E. All detailed design drawings and documents requiring changes must be revised prior to installation.

F. The Contractor must 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 must 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 must be new and must meet the requirements of this RFP.

I. The Contractor must be responsible for preparing and submitting the necessary applications for site permissions/access to install system equipment at non-NCDJPA owned sites.

J. The Contractor must be responsible for any leases at non-NCDJPA 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 must be tested and verified to meet the manufacturer specifications. Any antenna, RF cable or waveguide not meeting specification must be replaced with new equivalent products, at the NCDJPA discretion.

B. All antenna work must be accomplished in compliance with the terms of the FCC licenses granted to the NCDJPA.

C. The Contractor must install radio frequency (RF) cable and waveguide without kinks or dents. Such installations must not exceed manufacturer specified bending radii.

D. RF cable and waveguide must 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 must install a coaxial cable lightning arrestor for all coaxial cable runs.

F. The Contractor must 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 must 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 must 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 must 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 must be used for the installation of all cabling.

F. All cabling must be labeled with an identifier on each end that clearly indicates where the cable is terminated at both ends.

G. The Contractor must clean all equipment and devices and repair all damaged finishes.

H. The Contractor must not use equipment supplied as spares for installation of the new system.

3.9.4 Work Sites

A. The Contractor must leave sites neat and broom swept upon completion of work each day.

B. The Contractor must thoroughly clean all equipment shelter and building floors and remove all scuff marks and abrasions prior to acceptance.

C. The Contractor must remove all trash weekly.

3.9.5 Inspection

A. All materials furnished and work completed must be subject to inspection by the NCDJPA.

B. The NCDJPA must conduct an inspection of the installations upon substantial completion.

C. The NCDJPA must document any deficiencies on a single punch list and provide the punch list to the Contractor for resolution.

D. Final acceptance testing must not commence until all punch list items are resolved.

3.10 Coverage Testing

A. The Contractor must submit a Coverage Acceptance Test Plan (CATP) that will validate the coverage requirements.

B. The CATP must comply with the following requirements:

1. The CATP must be consistent with the procedures and guidelines outlined in TSB-88 (current version).

2. Coverage testing must 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 NCDJPA discretion. The NCDJPA shall not be responsible for any additional costs associated with the retesting.

4. The CATP must 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 must perform the following types of coverage testing in both directions (talk-out and talk-in):

    a. Objective drive testing, which must 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 must provide the results of the objective tests to the NCDJPA for information only.

D. Test configurations:

1. Test configurations must 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) must be submitted to the NCDJPA for their review and approval prior to testing.

2. Objective drive testing:

    a. The Contractor must 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, must be identified in the proposal, and also must be measured by the Contractor and approved by the NCDJPA prior to the start of the testing.

b. The Contractor must test at a statistically significant number of test locations throughout the guaranteed coverage area of each channel. The Contractor will work with NCDJPA 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 must 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, must be identified in the proposal, and also must be measured by the Contractor and approved by the NCDJPA prior to the start of the testing.

   b. The Contractor must 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) must 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 must 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 must document talk-out and talk-in performance separately for each test tile, and the overall system pass/fail percentages must be calculated for each direction distinctly. A failure in either direction will be noted as a failure for that test tile.

H. Subjective DAQ testing must show that 95% of the tiles tested within the guaranteed coverage area for each channel 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 must be deemed a failed test. The Contractor must 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 must provide a standardized test form for testing.

3.11 Acceptance Tests

3.11.1 General Requirements

A. Prior to testing, the Contractor must:

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 NCDJPA that the system is ready

3. Submit a Test Plan for review and approval by the NCDJPA

B. The Contractor must provide all test equipment and miscellaneous cables, adapters and parts required to perform all testing specified in this RFP.

C. The Contractor must calibrate all test equipment prior to testing.

D. Performance of all tests must be in the presence of NCDJPA or a NCDJPA-approved representative.

E. Testing requires the utilization of quality instruments in proper condition for all testing. Calibration records for all instruments must be available at the site during all testing.

F. Both a NCDJPA representative and the Contractor must sign the Acceptance Test Plan following successful completion of all tests. All tests in the Acceptance Test Plan must be marked as either pass or fail.

G. The Contractor must submit all test schedules to the NCDJPA for approval.

H. The Contractor must provide all necessary technical personnel and test equipment to conduct Acceptance Testing. All deviations, anomalies, and test failures must be resolved at the Contractor's expense.

I. The Contractor must document, repair, replace and retest any equipment that fails any test. The Contractor must replace and retest all defective components.

J. The NCDJPA 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 must use the completed and approved FATP.
2. The Contractor must successfully perform all FATP tests before the NCDJPA witnesses the official FATP.
3. The Contractor and the NCDJPA representatives must jointly execute and date the FATP following completion of all tests.
    a. All tests in the FATP must be marked as either pass or fail.
4. The Contractor must provide all necessary technical personnel and test equipment to conduct FATP tests.
5. All deviations, anomalies and test failures must be resolved at the Contractor's expense.
6. The Contractor must document, correct, and retest all failed components.
7. The Contractor must replace at its own expense any failed component that is not repairable.
8. Retest of individual failed FATP tests or the entire plan must be at the NCDJPA's discretion.
9. The Contractor must provide the NCDJPA 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 must 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 must include throughput, latency, packet jitter and frame loss.

3.12 Training

3.12.1 Training Programs

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

B. The Contractor must provide training for all new equipment, including, but limited to the conventional VHF repeaters, 900 MHz microwave radios, and all associated equipment.

C. The Contractor must provide technical/system management training, including:

1. Complete and comprehensive technical training as applicable to the system design

2. This training must include:

a. System theory

b. Troubleshooting

c. Repair

d. Servicing techniques

3. Technical training must 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 must provide system management training for technical staff responsible for managing the system, which must 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 must provide descriptions of all training programs they intend to provide, which must 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 must conduct all training at a location where duplication of system operation will not impact daily operations.

G. The Contractor must coordinate with the NCDJPA regarding number of attendees, schedule, and training location.

H. The Contractor must schedule classes as close to system cutover as possible.

I. The Contractor must train the NCDJPA employees or designated individuals.

3.12.2 Training Materials

A. The Contractor must 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 NCDJPA and must become property of the NCDJPA.

C. Training materials must 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, must be specific to the NCDJPA 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 must provide fully editable (softcopy) versions of all training materials so that the NCDJPA trainers can update the course materials.

E. The Contractor must provide unit pricing for all media (e.g., CDs, DVDs, and Manuals) used for training.

F. The pricing provided must be valid for a period of 3 years following system acceptance.

3.13 System Cutover

3.13.1 Cutover Plan

A. The Contractor must develop a Cutover Plan for review and approval by the NCDJPA. The NCDJPA reserves the right to approve and change the cutover plan as it relates to any or all system components. The Cutover Plan must 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 must be responsible for planning and coordinating the implementation of all equipment, subsystems, and the overall system.
3. The Contractor must:
    a. Be responsible for any costs associated with their proposed cutover plan.
    a. Program the users' existing and/or new radios
    b. Identify the cutover of individual circuits
    c. Identify temporary alternate routing of critical circuits
    d. Include fallback, recovery, and contingency plans to mitigate the risk of circuit failure during cutover
    e. Maintain reliable and stable communications
    f. Ensure the timely deployment of a complete and functional network

g. 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

h. 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 NCDJPA**.**

B. The Cutover Plan must 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 must deliver a Draft Cutover Plan describing how the existing radio systems will be migrated to the new system.

D. The Cutover Plan must include the schedule and procedures associated with the transition of each operational user group.

E. The Cutover Plan must specifically address how the existing users will begin using the new system with minimal operational impact.

F. The Cutover Plan must provide detailed component or subsystem cutover plans, and specifically delineate between systems that affect and do not affect ongoing operations.

G. The NCDJPA 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 must execute the system cutover according to the approved Cutover Plan.

B. Any modifications to the plan must be proposed to and approved by the NCDJPA at least ten business days prior to execution.

C. The Contractor must provide 5 business days advance notice for required outages of the existing system during the cutover. All planned outages require approval of the NCDJPA.

D. The Contractor must provide the necessary labor to cutover from existing systems to the new system.

3.14 30-Day Operational Verification Period

A. The Contractor must plan a 30-calendar-day operational burn-in period for the entire system.

B. The conditions of the test must be determined during Final Design with plans including loading the system as fully as approved by the NCDJPA.

C. Technical staff from the NCDJPA and the County and/or other designated experts shall monitor the burn-in period.

D. The Contractor must 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 any Zone

    b. Any failure of one or more Contractor-supplied repeaters at any site within any Zone

    c. Any failure of Contractor-supplied antenna system which causes a loss of voice communications at any site within any Zone

d. Any failure of one or more Contractor-supplied switches and/or routers at any site within any Zone

G. A minor failure will cause the burn-in period to temporarily hold until the issue has been fully resolved to the NCDJPA satisfaction.

1. After resolution of the failure, and with NCDJPA 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 must 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 must be defined as a major failure.

J. Two or more repetitive minor failures with the same root cause must 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 NCDJPA is satisfied there is little likelihood of a systemic recurring issue.

3.15 Decommissioning, Removal, and Disposal of Legacy Equipment

A. The Contractor must 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 NCDJPA.

B. The Contractor must 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, must warehouse, as necessary, removed equipment prior to disposal.

D. The Contractor, at its sole expense, must transport all removed equipment to the NCDJPA-specified disposal location.

E. The NCDJPA is interested in obtaining trade-in for all NCDJPA-owned equipment that will be removed from service. At the request of the NCDJPA, the Contractor must provide a list of trade-in amounts.

F. Equipment purchased by the Contractor as Trade-In must be removed and handled according to the terms of any applicable Trade-in agreement.

3.16 As-Built Documentation

A. The Contractor must 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 must 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 must be 11" x 17"

C. The Contractor must 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 NCDJPA 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 must be new and covered by a full manufacturer's warranty for 3 years, commencing with NCDJPA final acceptance of all Mutual Aid Zones.

B. System performance, installation, and all hardware, parts, software, and materials (including third-party equipment) must be warranted for a period of 3 years.

C. Warranty coverage must 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 must 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 NCDJPA's technical staff shall be the first line of maintenance with the Contractor providing support as required.

1. NCDJPA's personnel will escort the Contractor to all sites requiring Contractor level on-site support.

G. During the warranty period, service and repair must be performed 24 hours a day, 7 days a week, 365 days a year.

1. There must be no additional charges for work outside of normal Contractor business hours.

H. The NCDJPA 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 must be in effect:

1. The Contractor must contact the NCDJPA within 30 minutes of telephone notification for a Critical Service issue.

2. The NCDJPA 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 any Zone

   b. Any failure of one or more Contractor-supplied repeaters at any site within any Zone

   c. Any failure of Contractor-supplied antenna system which causes a loss of voice communications at any site within any Zone

   d. Any failure of one or more Contractor-supplied switches and/or routers at any site within any Zone

3. The Contractor's qualified service representative and the NCDJPA's representative must 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 NCDJPA's representative cannot resolve the issue remotely or over the phone, then the NCDJPA shall make the determination regarding the criticality of the service issue.

   a. If determined to be critical the Contractor must dispatch a qualified service representative to the site experiencing the service issue.

5. The Contractor's qualified service representative must be physically present at the site that requires service within 4 hours of NCDJPA's decision to escalate the call to on-site service.

6. On-site Contractor's service representative must make every effort to resolve the Critical Service issue within 12 hours from the time the critical service issue was reported.

J. The Contractor must repair all equipment, hardware, and software throughout the implementation, cutover and warranty periods.

K. The following procedures must be followed during the warranty period:

1. The Contractor must provide the NCDJPA 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 NCDJPA-owned spares to complete a repair, the documentation must 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 must maintain a comprehensive tracking system to track units to and from the factory/depot.

L. Replacement parts must be new or original repaired parts only.

M. Fixed equipment mail-in board repair must be completed within seven calendar days of receipt.

N. Equipment must be returned to the NCDJPA via second-day shipping, with tracking number provided to the NCDJPA.

O. Serialized units sent in for depot repair must not be exchanged unless specifically authorized by the NCDJPA.

P. The original unit must be repaired and returned unless specifically authorized by the NCDJPA.

Q. Software and Firmware:

1. The Contractor must warrant all software and firmware.

R. During the installation, warranty, and extended warranty periods, the Contractor must provide, at no additional cost, commercially available upgrades of all software and firmware originally sold to the NCDJPA.

S. The frequency and timing of installation of upgrades during this period shall be at the sole discretion of the NCDJPA based on availability by the Contractor.

T. The Contractor must provide all back-up media and revised software manuals to the NCDJPA at the time of any software revisions at no cost.

U. The Contractor must update all devices to the same and latest release level prior to the conclusion of the warranty period at no additional cost to the NCDJPA.

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 NCDJPA.

a. If the defect is deemed by the NCDJPA to be systemic after the investigation is completed, the Contractor must then be responsible for replacing at no additional cost to the NCDJPA 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 NCDJPA, must 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 must correct all system malfunctions due to software at no additional cost to the NCDJPA.

Y. If, during the first 5 years after System Acceptance, 25% of any type of Contractor supplied equipment or material fails, Contractor must replace this equipment or material at no additional cost to the NCDJPA.

4.2 Parts Availability

A. The Contractor must certify that replacement parts for all delivered equipment must 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 must send written notice to the NCDJPA 24 months prior to the date of discontinuance to allow for last-time buys and spares replenishment.

4.3 Spare Equipment

A. The Contractor must supply all spare equipment in new condition.

B. The Contractor must include recommended initial spare parts and test equipment to be procured as part of the initial contract. The NCDJPA 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 must 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 NCDJPA maintenance activities

D. Initial spares for less critical items must also be enumerated

E. The spare parts and equipment must 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 must determine the types and quantities of spares based on their proposed system size and design.

G. The Contractor must 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 must provide and price a list of recommended test equipment and applications.

4.4 Lifecycle Support

A. Any Contractor-supplied products (including 3rd party equipment) shall not be accepted with components or modules at the end of their respective lifecycles.

B. The Contractor must 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 must provide spare parts and equipment at a discounted rate for the life of the contract.

E. The Contractor must provide technical support at a discounted rate for the life of the contract.

F. The Contractor must provide engineering services at a discounted rate for the life of the contract.

4.5 Post-Warranty Support

A. The Contractor must offer the OPTION to purchase extended warranty for all supplied equipment. It is NCDJPA's desire to self-maintain the system, after the warranty has expired.

B. The Contractor must 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 must 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 must provide discounted software support and upgrades for the system.