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1 SYSTEM LEVEL REQUIREMENTS

1.1 Desired Digital Radio System Level Functional Capabilities

1.1.1 The Proposer shall propose a comprehensive multi-site trunked APCO P25 digital radio communications system design that will provide significantly enhanced capabilities when compared to the current analog technology. This includes improved countywide coverage, enhanced operational features and expanded radio subscriber call loading, especially during critical events.

1.1.2 The proposed replacement radio system shall conform to and support the Project 25 Common Air Interface (CAI) and utilize Project 25 trunked operation for channel access. The proposed design and equipment configuration shall implement P25 Phase II (H-DQPSK/TDMA), with dynamic access on a per channel basis to P25 Phase I operation where required for interoperability purposes.

1.1.3 The system proposed also must include the ability to add system elements over time. This scalability includes being able to accommodate added radio sites, dispatch consoles, and mobile and portable radios. The system proposed must also be able to add features and functions and must be able to be expanded to include other counties and jurisdictions as may wish to join the PSERN system over the useful life of the system. Finally, the backhaul network proposed in the Proposal to support the system must be scalable in order to increase its capacity over the life of the proposed microwave network.

1.1.4 Proposers shall offer a full turn-key system solution that includes all of the components and capabilities of this RFP.

1.2 P25 AES Encryption and Over the Air Re-Keying (OTAR)

1.2.1 Digital voice encryption using Project 25 AES encryption is required for law enforcement and possibly medical first responder radios. The system should support over-the-air-re-keying (OTAR) of mobile and portable radios using the Project 25 OTAR standard. Proposers shall elaborate on the requirements to implement these features, to include the following:

1.2.1.1 Encryption and OTAR as standard features
1.2.1.2 Disclose quantity of keys supported for each encryption mode
1.2.1.3 Itemize required hardware, software or firmware to implement these capabilities
1.2.1.4 Disclose associated cost per subscriber unit and per system to implement these capabilities
1.2.1.5 Completely software enabled, requiring no physical modification of the subscriber equipment
1.2.1.6 Indicate if encrypted operation has any impact on received and transmitted audio quality
1.2.1.7 Estimate OTAR ‘push times’ to perform a radio re-key to a single (qty. 1), small group (qty. 100) or fleet (qty. 1000) of subscriber radios

1.3 Other Voice Privacy or Encryption Schemes

1.3.1 AES-256 and DES-OFB are the required encryption schemes for the proposed replacement radio system. Proposers offering non-AES, non-DES-OFB digital voice privacy, scrambling, or other encryption schemes that are otherwise considered proprietary shall disclose their suitability for implementation in the proposed radio system. Cost, benefit
and performance analysis as well as impacts to system operation and user experience (i.e., transparency of operation, recovered audio quality, etc.) shall also be disclosed for any non-standard forms of encryption proposed.

1.4 Encryption Standards and Requirements
1.4.1 System infrastructure proposed shall provide AES-256 and DES-OFB encryption. All first responder agency radios shall include AES-256 and DES-OFB and shall store multiple keys per radio. Radios proposed shall provide at least 16 keys per subscriber radio equipped with encryption, with multiple Common Key references (CKR’s)

1.4.2 Proposed infrastructure should support end-to-end encryption from:
1.4.2.1 Subscriber radios to dispatcher consoles
1.4.2.2 Subscriber radios to logging recorders

1.4.3 Key management shall meet these required capabilities:
1.4.3.1 Key management capabilities shall extend across the entire system.
1.4.3.2 Keys shall also be manageable by a subregion.
1.4.3.3 Keys shall also be enterable from portable keyloaders
1.4.3.4 Keys shall also be enterable from keyloaders where the stored keys are not available for viewing by the user

1.5 Over the Air Re-Keying (OTAR) Capability
1.5.1 OTAR is required to be supported at the infrastructure level
1.5.2 NIST FIPS140-2 compliance is required
1.5.3 OTAR shall be supported by a single KMF Server. Multiple KMF clients shall be required.

1.6 KMF Clients Locations
1.6.1 Proposer shall provide KMF Clients at the following locations:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Seattle Radio Shop</td>
<td>Seattle</td>
</tr>
<tr>
<td>EPSCA Administrative Office</td>
<td>Redmond Police Department</td>
</tr>
<tr>
<td>King County RCS</td>
<td>SeaTac</td>
</tr>
<tr>
<td>Valley Communications</td>
<td>Kent</td>
</tr>
</tbody>
</table>

Table 1.61 KMF Clients Locations

1.7 Radio Subscriber Location Capability
1.7.1 The Owner desires the capability of locating radio subscribers for fleet management, first responder safety and efficiency of dispatching required assets to the scene of a call. The Owner is aware of multiple technologies currently available that provide positional reporting of radio subscribers that can integrate with software applications to provide dispatchers a graphical representation of radio subscriber locations.

1.7.2 The Proposer shall detail any location-based technologies supported in their offered solution that the Owner and PSAP dispatchers can benefit from. These include, but are not limited to radio site-based triangulation of radio subscriber transmissions, and GPS-based methods. The system infrastructure shall support the gathering of location data from all...
subscribers and be delivered by the offered system to multiple Computer Aided Dispatch (CAD) systems at the following facility locations:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>King County Sheriff’s Office Dispatch</td>
<td>Renton</td>
</tr>
<tr>
<td>NORCOM</td>
<td>Bellevue</td>
</tr>
<tr>
<td>Seattle Fire Dispatch</td>
<td>Seattle</td>
</tr>
<tr>
<td>Seattle Police Dispatch</td>
<td>Seattle</td>
</tr>
<tr>
<td>Valley Communications</td>
<td>Kent</td>
</tr>
</tbody>
</table>

Table 1.71 Computer Aided Dispatch (CAD) Systems

1.8 P25 Inter Sub-System Interface (ISSI)

1.8.1 Proposers are to include TIA-102.BACA-B ISSI implemented in its latest release or iteration as a required capability. The present system, known as the Tri-County Regional Interoperability Committee (TRIC), uses a Motorola switch that supplies up to 64 talkgroup connectivity per link, with provisioning for up to 27 simultaneous talkgroups to be in operation over each link. The present configuration provides the ability for participants to patch:

1.8.1.1 Tacoma talkgroups to King Co. talkgroups,
1.8.1.2 King Co talkgroups to SERS talkgroups,
1.8.1.3 Tacoma talkgroups to SERS talkgroups (via the King County 7.x switch – there is no direct connection between Tacoma and SERS).

1.8.2 Proposers shall include all labor and materials to configure the Owner end of the ISSI link, including cooperative configuration planning, testing and implementation with the owner of the ‘other end’ of the ISSI link.

1.8.3 The longer term goal is to create a radio system environment throughout the central Puget Sound that includes automatic roaming between regional radio systems in Snohomish and Pierce Counties. Proposers are to include in their offering all labor and materials costs required to later upgrade the proposed system to the latest approved released of TIA-102.BACA-B ISSI.2 when available prior to the end of the initial 2 year warranty period.

1.8.4 ISSI links, including all supporting equipment and services shall be provided for interconnection with the following P25 systems:

1.8.4.1 Pierce County / South Sound 911 (including the City of Tacoma / City of Puyallup system) – Provisioned to support 27 simultaneous talkpaths
1.8.4.2 Snohomish County (SERS) – Provisioned to support 27 simultaneous talkpaths
1.8.4.3 Washington State Patrol (WSP) – Provisioned to support 8 simultaneous talkpaths
1.8.4.4 Washington Department of Transportation (WSDOT) – Provisioned to support 4 simultaneous talkpaths
1.8.4.5 Port of Seattle – Provisioned to support 16 simultaneous talkpaths
1.8.5 The present Motorola ISSI.1 switch interconnection method used with systems outside the Owner system is as follows:

1.8.5.1 The connection between King Co and Snohomish County (SERS) is Ethernet and transits the existing Owner north loop microwave to handoff ISSI traffic with SERS.

1.8.5.2 The connection between the Owner and Tacoma/Puyallup (Pierce County) is T1 and transits the South Loop microwave to handoff ISSI traffic with Tacoma/Puyallup.

1.8.6 Proposers shall identify if the existing connections to outside agencies are acceptable for their ISSI solution and if so, disclose expected ISSI functionality as implemented. If not acceptable, proposers shall indicate what network connectivity is required in order to support their ISSI transport implementation.

1.9 P25 Trunked Operation Feature Requirements

1.9.1 The system shall support talk group operation, where a talk group consists of a number of operational users who wish to maintain common communications distributed throughout the radio network. The radio user manually selects the talk group they wish to communicate with, and then presses PTT on the radio. If resources are available the system shall respond by establishing a voice call to the selected group.

1.9.2 Once the group call has been established, audio from the source radio is transmitted to all members of the group, which may involve multiple repeater sites. The system shall track talk group members as they roam through the network and ensure that each multi-site call is routed to all available repeater sites containing members of that talk group.

1.9.3 The system shall allow the specification of critical sites that need to be included in a group call even if no user is logged into that site on that talk group (confirmed call). The system should allow the specification of a timeout timer associated with the confirmed call to allow the call to proceed in the case where a critical site is too busy to support the call.

1.9.4 The following list identifies key functional requirements to be provided for the user of the 700/800 MHz P25 trunked radio system in the Standard P25 configuration.

1.9.4.1 Queuing

1.9.4.1.1 If resources are not immediately available for a call originating from the network side, the system shall queue the channel request to the base station until the radio channel is available or other defined timers have expired.

1.9.4.2 Talk Prohibit Tone

1.9.4.2.1 Upon being notified the system is busy and the call request is queued, the radio shall emit a tone to indicate the call is queued.

1.9.4.3 Talk Group Priority

1.9.4.3.1 The system shall queue radio subscriber initiated call based upon talk group priority. Calls shall be positioned in the queue based on priority, with calls of highest priority being serviced first. Calls of equal priority shall be processed on a first in, first out basis.

1.9.4.4 Recent User Priority

1.9.4.4.1 The base station shall provide a mechanism to allow recent users to receive consecutive assignments of a continuing talk
group conversation when there is a busy queue for channel assignments.

1.9.4.5 Priority Preemption
1.9.4.5.1 The system shall permit a high priority call originating from the infrastructure to immediately preempt a lower priority call on the same talk group.

1.9.4.6 Group Busy Lockout
1.9.4.6.1 Should a radio subscriber initiate a call request (via pressing PTT) on a talk group that is already busy, the system shall not process the call request. The system shall also provide the user with audible feedback that the call request has not been processed. Exceptions to group busy lockout include network originated emergency calls, dispatcher override, and supervisor override.

1.9.4.7 Dispatcher Override
1.9.4.7.1 The system shall permit a call originating from a dispatch console to interrupt a call by a normal member of the same talk group, overriding the call so that other members of the talk group only hear the dispatcher.

1.9.4.8 Individual or Private Call
1.9.4.8.1 The system shall support individual call mode, where a suitably equipped radio or console user can establish a private call to any other radio user in the network. In individual call mode the group membership is limited to the source and destination radios and the call will not be overheard by other mobile or portable units.

1.9.4.9 Priority Scan
1.9.4.9.1 The system shall provide individual subscriber radios with the capability of scanning multiple talk groups on a priority scan basis. Scan list parameters shall be software configurable and user modifiable.

1.9.4.10 Talkback Scan
1.9.4.10.1 The system shall provide individual subscriber radios with the capability of talking back to the most recent user on a scanned talk group. Scan list parameters shall be software configurable and user modifiable.

1.9.4.11 Scan Group Lockout
1.9.4.11.1 The subscriber radio shall provide the user with the ability to temporarily disable scanning on selected talk groups. Scan list parameters shall be software configurable and user modifiable.

1.9.4.12 Emergency Alert and Emergency Call
1.9.4.12.1 The system shall support emergency call on mobile and portable radios. When the emergency button is pressed on a mobile or portable radio, the radio shall immediately transmit an emergency alert message over the control channel to a predetermined dispatch location. The emergency alert message should include the radio ID, alphanumeric alias and emergency
talk group if so configured. Upon receipt of an emergency alert message the system shall immediately establish an emergency voice call.

1.9.4.13 Late Call Entry
1.9.4.13.1 The system shall permit a user who has just re-entered radio coverage or was engaged in another call to late enter into a call in progress.

1.9.4.14 Multi-Group Call
1.9.4.14.1 The system shall permit a console or supervisor radio to initiate a voice call simultaneously to all radios logged into the system on different talk groups. The scope of the call shall be configurable to include up to fifteen (15) simultaneous talk groups in a single call.

1.9.4.15 System Wide Calls
1.9.4.15.1 The system shall permit a console or supervisor radio to initiate a system wide call to all radios logged into the system.

1.10 P25 Trunked System Simulcast Architecture
1.10.1 The PSERN system will operate in a spectrum-constrained region of Washington State. Because it is the desire of the Owners to reuse the existing 800 MHz spectrum resources that are presently deployed as part of the legacy regional system, and because the benefit of simulcast/voted radio system infrastructure in supporting effective in-building communications has been proven in the region, it is likely that the proposed system will make use of one or more simulcast “cells” in order to serve the region. Use of multicast sites is assumed to be limited to sites that serve more remote areas such as highways that traverse mountain passes or for specific tunnel or ‘campus’ locations.

1.10.2 Based on prior work by Owner, it is expected that a significant number of new simulcast radio sites are required to serve the PSERN coverage area. Simulcast technology provides benefit in spectrum-deficient 800 MHz regions and in areas with diverse topography that present challenges with multicast implementation. The region PSERN serves fits this description and utilizes simulcast technology in its current analog trunking system.

1.10.3 The Owner understands that improvements in digital simulcast modulation technology by some vendors has resulted in higher performance and more relaxed radio site spacing distances than previous implementations. Owner desires to exploit these latest technologies. Proposals based upon simulcast transmission technology on 800 MHz, combined with digital receiver voting are required in order to allow for optimized radio site spacing and configurations.

1.10.4 Multiple simulcast cells may be required to serve the defined coverage area. Proposers must clearly identify the expected architecture, groupings of sites and the proposed number of channels required at each sited based on the preliminary talkgroup data provided by the Owner.

1.10.5 While improved coverage is a paramount consideration for the system, proposers should be aware that development of new sites will involve capital costs for the Owner or the Proposer, as well as increasing the total cost of system ownership. These added costs are a part of the evaluation of Total Cost of Ownership (TCO) and Proposers are encouraged to carefully consider their site design with regard to these costs.
1.11 Simulcast versus Multicast System Design

1.11.1 Moving from the present mix of high elevation and moderate elevation radio sites to a system architecture based entirely on use of low sites is perceived as having significant site development cost and complexity, as well as greatly increased recurring costs for new site leases and system maintenance. Regardless, if a Proposer has a differing architecture to propose that includes compelling arguments in terms of enhanced radio system performance, reduced capital or operational costs, or enhanced operational efficiency, Proposers are encouraged to include alternative architectures in their Proposal.

1.12 Concept for Future Coverage Cells

1.12.1 During past discussions, regional partners have envisioned three (3) large simulcast cells as serving the majority of populated King County. While Proposers are to provide system proposals based on their view of the optimal solution, for Proposers that wish to offer simulcast architectures, prior Owner thinking about an optimal configuration that is reflective of user agency operational patterns has envisioned three large simulcast subsystems that would be designed to cover the majority of King County. These notional simulcast cells are shaped to fit the operational patterns of user agencies. These three (3) conceptual cells have been thought to be roughly as follows:

1.12.1.1 A West Simulcast that generally serves the City of Seattle.

1.12.1.2 A North Simulcast that generally serves the area north of Interstate 90 and areas east of the West Simulcast. The City of Bellevue must be fully covered within this cell or within one of the proposed cells.

1.12.1.3 A South Simulcast that generally serves areas south of Interstate 90 and areas east of the West Simulcast.

1.12.2 More remote areas, especially those areas that traverse difficult terrain, including valleys and mountain passes, may be served by either simulcast cells or multicast sites. These remote areas are generally described to include the following areas:

1.12.2.1 State Highway 2 extending east from Monroe, Goldbar, Sultan and Index (all in Snohomish County), through to the town of Skykomish (in King County) and from there to Stevens Pass (on the edge of King County)

1.12.2.2 Interstate 90 extending from North Bend, to the Fire Service Training Academy at Bandera and east via to Snoqualmie Pass (the east King County line is at the Pass)

1.12.2.3 Highway 410 from Enumclaw to Greenwater using directionalized coverage from a site at Grass Mountain

1.12.3 Multicast sites might be used for in-building coverage within simulcast cells or other unusual campus requirements.

1.12.4 Low elevation microcell base stations may also be used to support communications in rural locations where the development of high altitude sites is impractical or impossible.

1.12.5 In-building coverage may be provided by DAS systems, either fed directly off of a nearby radio site using analog fiber connections or using channelized off-air BDA systems.

1.12.6 Proposers should be aware that a number of cities within King County have boundaries that extend into adjoining counties. These include the City of Bothell, the City of Auburn and the City of Pacific.

1.13 Microcell Coverage Enhancement Solutions

1.13.1 Proposers that have a ‘microcell’ product should describe those products, note if they are used as a part of their proposed system coverage solution and include pricing for these
subsystems in their Proposal cost. If not used as a part of the wide area system design, if available from the Proposer, Proposals should include pricing for microcell systems as “optional pricing”.

1.14 Additional Coverage Methods

1.14.1 The Owner seeks a proposed design solution that does not depend upon the use of vehicular repeaters or the use of distributed antenna systems (DAS) anticipated beyond those already in operation by government agencies and private owners in the region. As such, coverage as proposed should be based solely on the coverage provided by the wide-area radio system.

1.15 Microwave and Network Transport

1.15.1 Key to the long term successful operation of the PSERN is a high-reliability, high-availability, IP technology microwave transport system. The current microwave transport is circuit switched (TDM) technology based upon Harris / Aviat microwave infrastructure. The transport system has served the region well. The new PSERN will require new sites to provide the expanded coverage for the region, will add more complexity for backhaul needs in King County, and is expected to be more efficiently managed using an MPLS switched transport approach.

1.15.2 A state-of-the-art microwave backhaul network shall be constructed to support the Owner’s expanding communications needs well into the future. A Multi-Protocol Label Switching (MPLS) network transport layer overlaid on top of the physical IP microwave system will allow Owner to manage dedicated bandwidth and Quality of Service (QoS) based upon prioritized needs of system users. These elements shall serve to build the foundation for the next generation digital microwave transport for the region.

1.15.3 From a broader perspective, the Owner will benefit from enhanced interoperability technology provided by the APCO P25 Inter Sub System Interface (ISSI) with its regional partners, and in this “system of systems” approach, a robust and high-availability microwave transport system is crucial.

1.15.4 The Owner, through this RFP process, desires the Proposer to design, install and commission a full, turn-key, county-wide digital IP microwave transport system to not only support the connectivity requirements of the replacement radio system infrastructure, but to serve as foundation for future system growth.

1.16 Radio System Bandwidth Requirements Disclosure

1.16.1 To make a quantitative comparison of all Proposers’ network bandwidth requirements, the Proposer shall disclose network performance requirements reported in kbps, assuming full IP transport. For purposes of this representation, Proposer shall consider TDM circuits (T1 or fractional DS1) transport as IP, and present kbps/mbps requirements for proper system functioning. This data shall be supplied in the form of a circuit matrix on a per-site and individual RF channel level to optimally support each site, and the overall system assuming reliable operation during a 100% loaded condition, including specification of each of the following elements on both a per-hop and system basis:

1.16.1.1 Data capacity/bandwidth requirements

1.16.1.2 Minimum committed information rate

1.16.1.3 Maximum delivered latency

1.16.1.4 Maximum jitter

1.16.2 These performance requirements shall detail any particular specifications that apply to the primary system server as well as backup system server requirements. Should link encryption be recommended for Ethernet site links, the Proposer shall outline any...
increased bandwidth demands and additional hardware requirements this option imposes on system design.

1.17 Microwave System “Excess Bandwidth” availability for all Microwave Circuits

1.17.1 To make a quantitative comparison of all Proposers’ available network bandwidth, the Proposer shall identify the remaining residual bandwidth available for transport after all radio traffic requirements for all systems (VHF, 700 MHz and 800 MHz, both trunked and conventional, including inter-switch and inter-console requirements) included in the Proposal have been accounted for. Proposers shall disclose network performance for the remaining residual network bandwidth requirements, the Proposer shall disclose network performance requirements reported in kbps, assuming full IP transport. For purposes of this representation, Proposer shall consider TDM circuits (T1 or fractional DS1) transport traffic load as IP, and present kbps/mbps requirements for proper system functioning. This available ‘excess capacity’ data shall be supplied in the form of a circuit matrix on a per-site and individual RF channel level to optimally support each site, and the overall system assuming reliable operation during a 100% loaded condition, including specification of each of the following elements on both a per-hop and system basis:

1.17.1.1 Data capacity/Bandwidth requirements for the remaining excess capacity
1.17.1.2 Minimum committed information rate for the remaining excess capacity
1.17.1.3 Latency limitations for the remaining excess capacity
1.17.1.4 Jitter limitations for the remaining excess capacity

1.18 Disclosure of Proprietary Technology (Features, Functions or Capabilities)

1.18.1 The Owner is seeking the acquisition of a best-in-class digital trunked radio system based upon APCO P25 open standards. The Owner is aware that Proposers may elect to implement equipment features and capabilities that utilize proprietary extensions of the P25 defined standards for competitive and other market-driven reasons. While this has the potential to offer increased radio system capabilities and performance, it may preclude multi-vendor solutions from operational compatibility.

1.18.2 This includes, but is not limited to:

1.18.2.1 Radio subscriber roaming behavior
1.18.2.2 Radio subscriber or dispatch console feature decoding capability
1.18.2.3 Encryption technology incompatibility
1.18.2.4 Network-connected dispatch console equipment incompatibility or reduced feature set

1.18.3 Each Proposer shall fully disclose and clearly identify any proprietary technology offered as part of the proposed system design.

1.18.4 In addition, the Proposer shall clearly specify any features, capabilities or operational limitations imposed upon the overall radio system operation, due to utilizing subscriber radio or dispatch console equipment procured from subcontractors other than the Proposer’s manufacture.

1.18.5 In short, the Proposer must outline any overall impact to dispatch operations or radio subscribers on the system when a proprietary feature or function is implemented that is not available to, or detectable by, a subset of radio subscribers.

1.18.6 Please refer to TIA-102C Feature Requirements in Section 2 which outlines the TIA-102 Features in a matrix list format. All Proposers should indicate feature compliance referenced to the TIA-102 Feature matrix as part of their submittal.
1.19 Encryption Management

1.19.1 A subset of PSERN subscriber radios and dispatcher consoles shall be equipped with voice encryption to fulfill mission requirements and also allow interoperable communications with partner agencies who presently use or will be implementing encryption.

1.19.2 The Owner, as part of its regional planning efforts, expects to adopt a security doctrine for the generation, distribution, management and sharing of encryption keys for secure voice communications.

1.19.3 The Proposer shall offer a complete encryption management system with all hardware and software components needed to implement end-to-end voice security on the radio system based upon FIPS-140-2 Security Certification Guidelines and supporting AES-256.

1.19.4 Support for DES-OFB encryption standard if required by Proposer transition strategy.

1.20 Key Management Facility (KMF)

1.20.1 The Proposer shall offer a Key Management Facility solution to allow methodically organizing subscriber encryption requirements and distributing or changing encryption keys based upon user associations. Access to keys shall be partitioned based upon user logon privilege.

1.20.2 The KMF facility shall be provided with redundancy based upon geographical separation.

1.20.3 The KMF shall support key fill transactions via OTAR and manually through a physically connected Key Variable Loader (KVL) or fill device.

1.20.4 The KMF platform shall be based upon the components listed below (or similar):

- 1.20.4.1 Microsoft Windows™ based Server with Crypto Card
- 1.20.4.2 KMF Server Software
- 1.20.4.3 Windows™ OS Client
- 1.20.4.4 KMF Client Software

1.20.5 For reliability and efficiency using OTAR key transactions, the KMF solution shall be capable of:

- 1.20.5.1 Verifying radio subscriber availability or within range status prior to key loading
- 1.20.5.2 Verifying successful key loading with remote subscriber units on a per-transaction basis
- 1.20.5.3 Automatically self-generate and store key material without external or manual means

1.21 Manual Keyloaders

1.21.1 Owner technicians require multiple encryption key variable loading (fill) devices to manage manual re-keying of subscriber radios or dispatch consoles. The Proposer shall offer a fill device solution that supports the the radio subscriber units and proposed dispatch consoles (should local or manual key-loading be required for encrypted operation).

1.21.2 The proposer shall include cost information for fifty (50) portable key fill devices with required accessories.

1.21.3 The key fill device shall have the following features:

- 1.21.3.1 LCD display of status and important data
- 1.21.3.2 Intuitive and easy, menu-based operation
1.21.3.3 Supports AES-256 and DES-OFB encryption keys simultaneously
1.21.3.4 Automatically self-generate and store encryption keys for AES-256 and DES-OFB
1.21.3.5 Multiple levels of password protection
1.21.3.6 Key transfer via store and forward method
1.21.3.7 Nickel Metal Hydride or Lithium Ion battery powered
1.21.3.8 Supplied with battery charger
1.21.3.9 Supplied with one of each keyloader cable type for each encryption-capable radio proposed

1.22 Over the Air Rekeying (OTAR)

1.22.1 The Owner faces a logistical challenge in maintaining encryption keys in large numbers of first responder radios. The ability to utilize OTAR to update subscriber units over the PSERN and not require users return their radios for manual keying is a desirable and efficient solution.

1.22.2 The Proposer shall offer a P25-compliant OTAR facility that enables key distribution and key management to be conducted securely over the PSERN.

1.22.3 The OTAR server shall provide a physically, electrically and geographically redundant configuration that provides for increased availability. Proposer shall include in the Proposal Key Management Facility (KMF) client work stations in the following quantities:

<table>
<thead>
<tr>
<th>Agency</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Seattle</td>
<td>3</td>
</tr>
<tr>
<td>EPSCA</td>
<td>1</td>
</tr>
<tr>
<td>King County</td>
<td>5</td>
</tr>
<tr>
<td>Valley Comm</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 1.22 KMF Client Work Stations

1.22.4 Final locations for the KMF clients shall be determined at the time of post contract detailed design.

1.22.5 If over-the-network rekeying is proposed it shall be compatible with all proposed consoles.

1.22.6 Proposers shall disclose the following information:

1.22.6.1 Estimated OTAR 'push times' to perform a radio re-key sequence to a single (qty. 1), small group (qty. 100) or fleet (qty. 1000) of subscriber radios assuming normal radio signal quality

1.22.6.2 Requirement for OTAR re-key 'push' to utilize control channel only, or option of utilizing a working channel within a trunked system for this purpose

1.22.6.3 Additional or optional hardware and/or software needed to add OTAR capability to infrastructure, to include cost
1.22.6.4 Additional or optional hardware and/or software needed to add OTAR capability to radio subscriber units, to include cost

1.23 Over the Network Rekeying of Consoles

1.23.1 The Proposer shall detail the capability of their console solution to support encryption rekeying via the Owner wired (IP) network in lieu of manual connection of key variable loaders or fill devices to a physical port on the dispatch console operator position or switch. Console rekeying shall be accomplished using the same central KMF and remote clients.

1.24 PSERN Topology

1.24.1 The graphic on the following page depicts an envisioned, conceptualized future PSERN topology. It is loosely based upon the present geography of King County, connectivity with regional radio system partners, and the desire for geographic redundancy of critical infrastructure. Proposers are invited to review this conceptual vision for references purposes only.
Figure 1.24 PSERN Topology
2 SYSTEM PERFORMANCE SPECIFICATIONS

2.1 Coverage Specification

2.1.1 The purpose of this section in the King County RFP is to clearly articulate the radio coverage requirements for the new system so that Proposers can develop their system design with a clear understanding of the Owner requirements. In support of this goal, this section defines each of the following:

2.1.1.1 A description of the PSERN required coverage area
2.1.1.2 The type of coverage required including mobile, and portable on street
2.1.1.3 Coverage requirements in special areas such as the incorporated cities within King County
2.1.1.4 Configuration/method of use of portable radios
2.1.1.5 Delivered Audio Quality (DAQ) performance (using both measured signal levels and EIA/TIA TSB-88 subjective testing)
2.1.1.6 Identifies the required coverage reliability throughout the defined coverage areas
2.1.1.7 The Coverage Acceptance Test (CATP) process that shall be used to ensure contractual compliance once the system has been completed

2.1.2 Because one of the primary goals of the new PSERN is to significantly improve on-street portable radio coverage across much of King County, the Owner is providing a variety of radio site data to Proposers in this RFP. This data includes the following elements:

2.1.2.1 A Reference Document with a listing of existing regional radio system tower locations within King County
2.1.2.2 A Reference Document with a listing of other facilities that may be useful in order for Proposers to offer system design Proposals that significantly improve first responder radio system coverage
2.1.2.3 A Reference Document with a listing of properties owned by agencies that participate in the King County regional system that may potentially support the development of new additional tower sites needed to meet coverage requirements
2.1.2.4 A Reference Document with maps detailed the three (3) bounded coverage areas. These include (1) Primary Bounded Coverage Area, (2) Highway Buffer Coverage Area, (3) Incorporated City Coverage Area

2.2 Definition of Coverage

2.2.1 For purposes of this RFP and any resulting contract, coverage is defined as the ability to successfully complete a round-trip communications event between two users through the radio system infrastructure, which meets or exceeds a level of DAQ 3.4. This includes inbound (field user to dispatcher), outbound (dispatcher to field user), and radio-to-radio voice communications in a repeat mode via the system infrastructure throughout the designated areas. This communication may take place while standing still or moving on foot or while in a vehicle at speeds of up to 80 mph. Under all of these conditions, communications shall be at a level of DAQ 3.4 (“Speech understandable with repetition only rarely required, some Noise/Distortion”) or greater.
This level of performance is required for both P25 clear voice digital and P25 AES-256 encrypted modes of operation.

2.3 Radio Operating Configurations

2.3.1 When specifying coverage requirements, providing coverage maps or testing coverage as a part of the Coverage Acceptance Test (CATP) process, the following definitions shall apply:

2.3.1.1 Portable On-Street - This means the proposed model(s) of portable radios, worn on the belt. Radios shall be equipped with a radio mounted ½ wave antenna and a standard speaker-microphone for purposes of predicting coverage and verifying resulting coverage criteria have been met in the Coverage Acceptance Test (CATP) process. Use of a radio holster, belt clip or leather case, without swivel, shall be used in coverage prediction.

2.3.1.2 Mobile – Mobile performance shall be that provided by a 35 watt mobile using a roof mounted unity gain antenna, connected with 12 feet of RG58 coaxial cable or equivalent.

2.3.2 The following gain/loss values are to be used in proposal coverage mapping.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Portable Radios</th>
<th>Mobile Radios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antenna Type</td>
<td>1/2 wave antenna on belt</td>
<td>Unity gain antenna</td>
</tr>
<tr>
<td>Antenna height</td>
<td>1 m = 3.3 ft. (hip level)</td>
<td>1.5 m = 5 ft.</td>
</tr>
<tr>
<td>ERP (before loss)</td>
<td>3 W = 34.8 dBm</td>
<td>35 W = 45.4 dBm</td>
</tr>
<tr>
<td>Antenna/body/cable loss</td>
<td>-14.3 dB</td>
<td>-1.5 dB</td>
</tr>
<tr>
<td>Approximate ERP (after loss)</td>
<td>20.5 dBm (-9.5 dBW)</td>
<td>43.9 dBm (13.9 dBW)</td>
</tr>
</tbody>
</table>

Table 2.3 Radio Operating Configurations

2.3.3 Proposal shall note any changes to these assumed values, including noting the revised gain/loss values.

2.4 General Coverage Criteria

2.4.1 The intent of this RFP, as it regards to radio system coverage, is to improve on-street coverage to 97% reliability over 97% percent of those areas of King County that fall within the defined bounded coverage areas, with a Delivered Audio Quality of DAQ 3.4 or better.

2.4.2 Proposers should be aware that a number of cities within King County have boundaries that extend into adjoining counties. These include the City of Bothell, the City of Auburn and the City of Pacific. When describing coverage in King County, Proposals shall include these areas, meeting the same coverage criteria established for those jurisdictions that lie entirely within King County.

2.5 PSERN Outdoor Coverage Requirements:

2.5.1 Provide 97% portable on-street coverage in the bounded area of King County. The bounded area includes the entire geography of King County west of the Cascade
Mountain foothill boundary, all cities, and all major roadways. The foothill boundary is defined as the first topographic contour that exceeds 1250 feet (AMSL) of elevation travelling eastward from the Puget Sound. There are areas west of the Cascade Mountains that are higher than 1250’ AMSL that shall also require coverage that meets these requirements. These higher elevation areas include what is known locally as the Issaquah Alps, as well as Tiger Mountain. A PDF map and GIS data sets for this data are provided in the technical data supplied to Proposers.

2.5.2 97% portable on-street coverage in each city (all cities should be included within the identified bounded areas). A PDF map and GIS data sets for this data are provided in the technical data supplied to Proposers.

2.5.3 97% portable on-street coverage along all major roadways (bounded areas should include the accessible areas following major roads, at a minimum: Interstate 90, State Highway 410, State Highway 18, and State Highway 2). The area in which this coverage is required is 500’ around the centerline of each roadway.

2.5.4 All waterways within King County and all lakes on which powered watercraft are permitted shall be provided with 97% portable on-street coverage. Lakes and rivers at elevations above 1250’ AMSL do not need to meet this requirement.

2.5.5 Coverage that meets the business requirements of agencies that respond to incidents in mountainous areas east of the bounded area of each county.

2.6 **Role of Distributed Antenna Systems (DAS)**

2.6.1 DAS systems are now required throughout Washington state as a result of statewide adoption of IBC2009. Additionally, several jurisdictions in King County have adopted additional, more stringent requirements that further seek to improve the availability of reliable in-building communications for first responders.

2.6.2 There are a number of government-owned DAS systems that are either presently directly connected to the King County regional system or will shortly be connected. These include light rail (Sound Transit light rail tunnels) and highway tunnels (the new Highway 99 tunnel being developed under the Seattle waterfront). These tunnels shall be provided with dedicated active multicast sites as part of the new PSERN, no specific Proposer coverage requirements exist for these tunnels.

2.7 **Balanced Design Required**

2.7.1 Recognizing that P25 trunked radio systems only function if a radio can both transmit to and be received by the system infrastructure, the system design proposed shall provide a balanced design for talk-in and talk-out communications. As a result, all system design present in the proposal shall represent those design elements that provide for a reliable link between user radios in the field and the infrastructure.

2.7.2 All Proposers providing maps shall reflect a balanced design and shall represent total round-trip performance. While automated signal level testing during the CATP reflect inferred uplink quality matching the downlink quality, selective testing of uplink performance shall be required or at least one measurement point in each and every tile within the agreed to test area. Additionally, DAQ testing shall be conducted where both the inbound and outbound communications path must pass at the DAQ 3.4 level or better.

2.7.3 Because the design for the King County PSERN is for a P25 trunked radio system, using a balanced transmit-receive design, and a full handshake between the
subscriber radio and the system infrastructure is required, coverage design and testing shall be based upon round-trip performance.

2.8 **Roaming Software**

2.8.1 If your proposed system utilizes roaming software in the user radios to change sites as the user radio moves throughout the King County service area, that software must be properly installed, calibrated, and optimized prior to radio coverage testing. As part of the Proposal design, site roaming will be an important part of day to day operation, and shall be factored into the coverage testing process. This means that if a radio fails to affiliate with the proper repeater site and the test calls are unsuccessful as a result, the test call fails.

2.9 **Simulcast Delay Interference**

2.9.1 If the proposed system configuration utilizes simulcast technology, the Proposer's propagation software must account for any harmful time delay that may occur in your proposed system design. This means that forecasted areas of delay interference must be clearly marked as “non-covered” areas if the introduced distortion will prevent the deployed system from meeting the required design coverage reliability. Proposers shall provide maps that clearly illustrate those areas where simulcast delay interference creates Delivered Audio Quality (DAQ) or BER reductions that impair system performance.

2.10 **Proposal Maps**

2.10.1 Maps shall be provided in the proposals that show areas where these criteria are met by the proposed design. Maps should be prepared that illustrate vendor design performance at sufficient detail to allow King County to clearly identify served and unserved areas.

2.10.2 For each of the coverage requirements, Proposers shall prepare predictive coverage analysis based upon their optimal recommended design utilizing existing and proposed sites, and provide maps with their Proposal illustrating delivered performance from their design. These maps shall illustrate coverage based with individual map sets that display signal strength gradients in dBm, uncorrected bit error rates (BER) and those areas meeting the delivered audio quality (DAQ) 3.4 or greater signal quality level.

2.10.3 Radio system coverage shall be predicted through the use of a radio propagation model which has been developed on the basis of theoretical and empirical data, and takes into account channel bandwidth, modulation schemes, delivered audio quality, coverage reliability, terrain irregularity, foliage, land use / land cover, building penetration losses, noise, and long- and short-term signal variations and other characteristics required to properly model area coverage for land mobile radio systems. The model used for the coverage prediction process shall be identified in the Proposal.

2.10.4 A table of system coverage design parameters used in the development of Proposal coverage maps shall be provided. This table shall include all system gains and losses used in the propagation analysis. The specific basis for using each system gain and loss value used shall be provided in the Proposal. A complete link budget for both inbound and outbound paths shall be defined.

2.10.5 Coverage analysis shall conform to TIA/EIA TSB-88 (latest release) and depict analog coverage for VHF, UHF, and 800 MHz interoperability systems, and P25 Phase I FDMA, using C4FM or linear mode if proposed (for primary trunked system and 700
MHz interoperability repeaters) and the predicted coverage using P25 Phase II TDMA (H-DQPSK) (6.25e) protocol. Maps provided for the VHF, UHF, 700 MHz and 800 MHz conventional interoperability systems are for information only and shall not have a coverage test associated with them. The depicted coverage criteria shall represent:

2.10.5.1 Portable operation outdoors (see next section for additional detail on this configuration)

2.10.6 Acceptable Channel Performance Criterion (CPC) for the Proposer's proposed radio system shall be referenced to TSB-88. Specifically, voice performance shall meet a defined minimum signal level for voice transmission and reception required to provide a Delivered Audio Quality (DAQ) 3.4.

<table>
<thead>
<tr>
<th>Coverage Type</th>
<th>Area Shown on Provided Maps</th>
<th>Criteria</th>
<th>Additive Build Loss Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile, Round Trip</td>
<td>1 map countywide, 1 map showing countywide coverage and signal delivered into adjoining counties, individual maps for each subsystem, and individual maps for each of the 39 cities. Individual maps for each site comprising a simulcast subsystem shall be provided for informational purposes, 1 map showing simulcast delay interference area.</td>
<td>97%/DAQ 3.4</td>
<td>None</td>
</tr>
<tr>
<td>Portable, Round Trip, On-Street</td>
<td>1 map countywide, 1 map showing countywide coverage and signal delivered into adjoining counties, individual maps for each subsystem, and individual maps for each of the 39 cities. Individual maps for each site comprising a simulcast subsystem shall be provided for informational purposes, 1 map showing simulcast delay interference area.</td>
<td>97%/DAQ 3.4</td>
<td>None</td>
</tr>
</tbody>
</table>

Table 2.10 Mobile and Portable Coverage Maps

2.10.7 Coverage maps for individual site analyses shall be delivered with Proposals on 11" x 17" media using a USGS 1:250,000 scale topographical maps. The scale on the finished map shall be 1" = 4 miles. Larger color plots may be required following submittal of the Proposal. High resolution map images shall be provided to allow enlargement and printing. If larger drawings or high resolution PDF files are required, you will be contacted by a representative of King County.

2.10.8 Each coverage analysis map shall include a legend with the following information:

2.10.8.1 Type of coverage displayed on the map. These configurations are:

2.10.8.1.1 Mobile, roof mounted unity gain antenna, trunk mounted radio, antenna height of 5’
2.10.8.1.2 Portable on-street, radio worn on belt in standard (non-swivel carry case), ½ wave antenna, standard speaker microphone, antenna height of 3.3’

2.10.8.2 Delivered Audio Quality of 3.4

2.10.8.3 P25 Phase II TDMA operation

2.10.8.4 Radio coverage reliability shown, percent reliability and type of reliability (area vs. contour)

2.10.8.5 RF signal levels in dBm corresponding to the coverage colors displayed on the map

2.10.8.6 Square mileage of each type of proposed coverage shown on the coverage analysis or on an accompanying parameter sheet

2.11 Map Boundaries

2.11.1 Maps shall be provided that allow for contractual confirmation of coverage. These maps shall define specific boundaries for each coverage cell that Proposers include in their coverage design. These shall include three (3) bounded coverage areas as follows: (1) Primary Bounded Coverage Area, (2) Highway Buffer Coverage Area, and (3) Incorporated City Coverage Area.

2.11.2 Additionally, all maps shall be provided in a format that does not limit coverage to the boundaries of the area to be tested. These maps shall be provided for informational purposes and shall not be used as a part of the CATP.

2.12 Maps Illustrating Coverage Beyond King County Borders

2.12.1 Proposers shall include a full set of maps illustrating the mobile and portable on-street coverage provided outside of King County. These are to be provided for informational purposes only.

2.13 Maps Illustrating Reduced DAQ Coverage Within King County Borders

2.13.1 Proposers shall include a full set of maps illustrating the mobile and portable on-street coverage with available DAQ of less than 3.4. provided inside of King County. These are to be provided for informational purposes only.

2.14 Map Data

2.14.1 All coverage maps shall be provided to King County in printed form as previously described, as electronic PDF files in the electronic copy of the Proposal and in electronic formats suited for use in GIS systems. The electronic versions shall be provided in a common GIS format for further coverage analysis by King County. The following map file formats are acceptable.

2.14.1.1 ESRI shape files

2.14.1.2 ESRI export files

2.14.1.3 MapInfo™ - Mif or Mid files

2.14.2 All predicted and CATP measured coverage data shall be provided as a single file for the entire coverage area and well as for each subsystem.

2.15 Terrain Data, Land Use and Land Cover Data

2.15.1 Proposers shall use a terrain database with a minimum of 3 arc-seconds of resolution and identify the terrain data model used in coverage predictions.
2.15.2 Proposer shall identify the land use/land cover loss values used in coverage predictions. The source and publication date of your land use / land cover database must be provided. The latest available USGS data shall be used. A separate 11”x17” map exhibit must be provided showing land use / land cover data used for this project showing where each use / cover category was used. A table that describes each use category and lists the loss value associated with it shall accompany this map.

2.15.3 For the purpose of developing and presenting computer generated predictive coverage modeling, Proposers shall adhere to the following format:

2.15.3.1 One set of maps depicting the coverage for APCO P25 Phase I (FDMA) operation based upon a one-for-one replacement of existing sites and base station counts. FDMA operation shall not be used to test system coverage or DAQ.

2.15.3.2 One set of maps depicting the coverage for Phase II (2-slot TDMA) operation based upon a one-for-one replacement of existing sites and base station counts.

2.15.3.3 One set of maps depicting the coverage for Phase II (2-slot TDMA) operation that would include a combination of existing and future developed sites to provide engineered coverage and performance.

2.15.4 Proposals shall provide maps that show King County in a single image, as well as maps that illustrate the coverage each of the major radio system subsystems individually. Sets of maps to be provided by Proposers are listed in Table 2.10.

2.16 Coverage Acceptance Test Procedure (CATP) Requirements

2.16.1 Coverage testing shall be conducted as part of the field system acceptance testing process to verify that the appropriate levels of coverage performance have been provided. King County staff shall supervise the entire coverage testing process. All expected CATP requirements are defined in detail in the CATP Test section of Section 10.2 of this RFP. The following are the broad requirements for CATP:

2.16.1.1 Automated signal level testing in dBm with measurement of both downlink and uplink quality.

2.16.1.2 Signal quality shall be outbound signal strength in dBm and both outbound and inbound Bit Error Rate (BER).

2.16.1.3 DAQ conducted where both the inbound and outbound communications path must pass at the DAQ 3.4 level or greater.

2.17 System Capacity

2.17.1 The required Grade of Service (GOS) for the PSERN shall be 1.0 or better across the high capacity portions of the entire system and all subsystems at busy hour of the busy day. In the context of the PSERN RFP, this means that during the normal busy hour of the day, no site shall experience greater than 1% calls having a busy and the average busy time for the hour shall not exceed 1 second. Sites may be either a single multicast site or a group of simulcast sites (which are treated as a single site for purposes of capacity planning).

2.17.2 This excludes “10-year events” such as civil disturbance, earthquake or other unusual public safety event. Also, the “normal busy hour” may vary from site-to-site and day-to-day.
2.17.3 The proposed system shall support a quantity of 30 (thirty) talk-paths per site within major subsystems.

2.18 Grade of Service (GOS) Defined

2.18.1 The term Grade of Service (GOS) is defined as the probability that any call request is blocked and the user is placed in queue. GOS is normally expressed as a percentage of calls placed into queue. A Grade of Service (GOS) of 1.0% or .01 means that on average, 1 of every 100 calls will be queued, calls in queue shall be granted in 1 sec. or less.

2.19 System Call Loading Data

2.19.1 Data concerning present system usage is present in Appendices to the Scope of Work Reference Documents (distributed by electronic means only) showing past usage levels by site (where such data is available).

2.19.2 Assumptions for Proposers

2.19.2.1 System shall be configured to allow talkgroup call to proceed even if channel resource is unavailable at all sites.

2.19.2.2 25% of the total radios on the system shall be active at the time of capacity simulation.

2.19.2.3 No patches shall be active and no channels shall be operating in FDMA mode.

2.19.2.4 No use of private call (individual call), or telephone interconnect capability.

2.19.2.5 Proposer shall assume one (1) emergency call is active in each large capacity subsystem.

2.20 Proposal Requirements

2.20.1 Proposer shall specify the following for the entire system, as well as for each subsystem (simulcast cells and multicast cells):

2.20.1.1 Number of sites and distribution of sites present in capacity planning design

2.20.1.2 Number of channels at each site

2.20.1.3 Resulting Grade of Service at each sites and across entire system

2.20.1.4 Proposer shall make use of the provided Motorola SystemWatch™ data to determine the appropriate call length by radio talkgroup type (police, fire, EMS, etc.). Average call length used for GOS design shall be specified by Proposer

2.20.1.5 Proposer shall make use of the provided Motorola SystemWatch™ data to determine the appropriate call arrival rate by radio talkgroup type (police, fire, EMS, etc.). Average number of calls per user/hour used for GOS design shall be specified by Proposer

2.20.1.6 Proposer shall make use of the provided King County talkgroup data to determine the assumed subscriber distribution across the system and subsystems

2.20.1.7 Proposer shall assume 20% adjacent site involvement between all major subsystems.
2.20.1.8 Proposer shall provide information in table format:

<table>
<thead>
<tr>
<th>Call Type</th>
<th>Number of Calls</th>
<th>Percent GoS @ 99% confidence</th>
<th>Erlangs</th>
<th>Mean Busy Queue Wait T (sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Call</td>
<td>To be completed by proposer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private Calling</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Telephone Interconnect Calls</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 2.20 System Call Loading Data

2.21 System Scalability

2.21.1 The proposed system must include the scalability to accommodate growth of Radio Sites, Dispatch Consoles, and Mobile and Portable radios by easily accommodating the addition of system elements over time.

2.21.2 The system proposed must also be able to add features and functions and must be able to be expanded to include other counties and jurisdictions that desire to join the Owner’s system over its useful lifetime. The microwave backhaul network proposed to support the Owner system shall also scalable in order to increase its capacity over the life of the proposed microwave network.

2.21.3 The proposed system shall provide scalability as much as possible to provide easy capacity upgrades to meet increasing call loading demands, and provide maximum flexibility for the Owner to address future subscriber growth.

2.22 System Availability

2.22.1 Proposers should be aware that the Owner system design requirements state that there shall generally be no single point of system failure in the proposed system Proposal design that can impact more than 25% of system capacity. Proposals that include system elements that may cause a loss of greater than 25% of system capacity shall note where those elements are present and the conditions under which failure may reduce system capacity by levels greater than 25%.

2.22.2 The system proposed shall be designed so that all traffic-impacting system components are redundant. This redundant design shall include all system elements that might require preventative maintenance. Specifically, all components, including power systems, shall be designed that each system may be placed into a maintenance mode, bypassing normal systems during maintenance of the specific element. This might include system servers, transport network elements, simulcast control equipment, and AC and DC power systems.

2.22.3 The Owner has established the following reliability targets for the PSERN:

2.22.3.1 Backhaul - No primary microwave hop or microwave loop (if so configured) shall operate with an availability of less than 99.999% of a year (excluding scheduled maintenance periods).

2.22.3.2 Radio Site - No primary radio site or subsystem shall operate with an availability of less than 99.999% of a year (excluding scheduled maintenance periods).

2.22.3.3 Power Systems - Final Power Source to All System Elements (AC power where AC is the supplied power to operate the system equipment and DC
power where DC is the supplied power to operate the system equipment) shall be at an availability level of 99.999%.

2.22.3.4 Mobile and Portable Radios - 99.999%. These availability requirements shall be tested during the “60-day bug free test” find proper term later.

2.23 Proposed Radio System Composite Performance

2.23.1 The Proposer shall identify the performance characteristics of the proposed system referenced to:

2.23.1.1 Reliability
2.23.1.2 Redundancy
2.23.1.3 Availability
2.23.1.4 Coverage
2.23.1.5 Quality standards

2.23.2 How the Proposer's solution addresses the above five criteria shall be clearly explained in qualitative and quantitative terms in the RFP narrative, citing (as an example, but not limited to):

2.23.2.1 Equipment configurations
2.23.2.2 Topology of design
2.23.2.3 No single-point-of-failure
2.23.2.4 Estimated % system and subsystem availability
2.23.2.5 MTBF (Mean-Time-Between-Failure)

2.24 System Resiliency during a Network, System or Site Failures

2.24.1 The Proposer shall provide a comprehensive overview of the system operation when any failure within the network occurs, to include multiple layers of failure. Detail the effects on radio and dispatch operation, as well as overall system functionality and limitations for failures to the following components or systems:

2.24.1.1 Group of connected sites isolated from the greater system
2.24.1.2 Recovery times from loss of power
2.24.1.3 Total loss of backhaul (i.e., microwave transport) for IP core
2.24.1.4 Partial loss of backhaul for IP core (single or multiple segments)
2.24.1.5 Wide Area Trunked System Controller(s) (main and standby, co-located or dispersed)
2.24.1.6 Simulcast Site Controller(s)
2.24.1.7 Router(s)
2.24.1.8 MPLS infrastructure
2.24.1.9 Control channel base station (in trunked mode)
2.24.1.10 Voice channel base station (in trunked mode)

2.24.2 Any inherent redundancy or self-healing design implemented by complimentary combination of hardware, software or topology shall be defined and demonstrated by explaining typical and non-typical loss recovery scenarios.
2.24.3 The significance of recommended locations of primary and backup (redundant) servers and their impact on fallback and recovery modes shall be explained. Fallback and recovery modes for systems with distributed control shall also be explained.

2.24.4 Explanation of modes of failure, automatic versus manual recovery procedures, fallback, and recovery scenarios through the use of color-coded or graphic illustrations is required.

2.25 System Availability Requirements during 60-Day Bug-Free Period

2.25.1 All defects (including minor defects) shall be resolved prior to System Acceptance. The installed system must be operational with no failures for a minimum of sixty (60) consecutive calendar days. Failures between the fifty-sixth (56th) and sixtieth (60th) day shall add fifteen (15) days to operational period. Failure on or before the fifty-fifth (55th) day shall restart the sixty (60) day interval.
### 2.26 TIA User Features Present in Proposed System

#### 2.26.1 TIA user features listing illustrating mandatory, standard optional required and standard optional system features. Proposers shall not which features are included as standard capabilities within their Proposal. Any features that are priced options shall be clearly shown in the Proposal.

#### 2.26.2 Conventional TIA-102 User Features Matrix List

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Requirement Level</th>
<th>Standards Doc. (TIA-102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unaddressed Voice Calls</td>
<td>Mandatory</td>
<td>102A</td>
</tr>
<tr>
<td>Group Voice Calls</td>
<td>Standard Opt.</td>
<td>102A, AABC-B, AABD</td>
</tr>
<tr>
<td>Discreet Listening</td>
<td>Standard Opt.</td>
<td>102A</td>
</tr>
<tr>
<td>Call Interrupt</td>
<td>Standard Opt.</td>
<td>102A</td>
</tr>
<tr>
<td>Monitor Squelch</td>
<td>Mandatory</td>
<td>102A, BAAD, CABA</td>
</tr>
<tr>
<td>Normal Squelch</td>
<td>Standard Opt.</td>
<td>BAAD, CABA</td>
</tr>
<tr>
<td>Selective Squelch</td>
<td>Standard Opt.</td>
<td>BAAD, CABA</td>
</tr>
<tr>
<td>System Call Standard</td>
<td>Standard Opt.</td>
<td>AABC-B, AABD, CABA, BAAD</td>
</tr>
<tr>
<td>Block Encryption</td>
<td>Standard Opt.</td>
<td>AAAD, AACA</td>
</tr>
<tr>
<td>AES Encryption of Voice</td>
<td>Standard Opt.</td>
<td>AAAD, AACA</td>
</tr>
<tr>
<td>AES Encryption of Packet Data</td>
<td>Standard Opt.</td>
<td>AAAD, AACA</td>
</tr>
<tr>
<td>Multiple Encryption Algorithms</td>
<td>Standard Opt.</td>
<td>AAAD, AACA</td>
</tr>
<tr>
<td>Multiple Encryption Keys</td>
<td>Standard Opt.</td>
<td>AAAD, AACA-A</td>
</tr>
<tr>
<td>Encryption Key Update</td>
<td>Standard Opt.</td>
<td>102A</td>
</tr>
<tr>
<td>Over the Air Rekeying (OTAR)</td>
<td>Standard Opt.</td>
<td>102A, AACA, AACB, Aacd</td>
</tr>
<tr>
<td>Call Alerting</td>
<td>Standard Opt.</td>
<td>102A, AABC-B, AABD, AABG, BACD</td>
</tr>
<tr>
<td>Pre-programmed Data Messaging</td>
<td>Standard Opt.</td>
<td>102, AABD, AABC, B, AABF-A, AABG, ABAA, BACD</td>
</tr>
<tr>
<td>Silent Emergency</td>
<td>Standard Opt.</td>
<td>102A, CABA</td>
</tr>
<tr>
<td>Radio Unit Monitoring</td>
<td>Standard Opt.</td>
<td>102A, AABG, AABC-B, BACD</td>
</tr>
<tr>
<td>Emergency Alarm</td>
<td>Standard Opt.</td>
<td>102A, AABC-B, AAB, AABG, BACD</td>
</tr>
<tr>
<td>Emergency Call</td>
<td>Standard Opt.</td>
<td>BAAD, AABFA</td>
</tr>
<tr>
<td>Radio Unit Inhibit*/Disable</td>
<td>Standard Opt.</td>
<td>102A, AABC-B, AABD, AABG</td>
</tr>
<tr>
<td>Radio Unit Uninhibit*/Re-enable</td>
<td>Standard Opt.</td>
<td>102A, AABC-B, AABD, AABG</td>
</tr>
<tr>
<td>Radio Check</td>
<td>Standard Opt.</td>
<td>AABD, AABC-B, AABG</td>
</tr>
<tr>
<td>Talking Party Identification</td>
<td>Standard Opt.</td>
<td>102A</td>
</tr>
<tr>
<td>CAI Common Air Interface</td>
<td>Mandatory</td>
<td>102A, BAAA-A</td>
</tr>
<tr>
<td>Phase I IMBE Vocoder (Full Rate)</td>
<td>Mandatory</td>
<td>102A, BABA</td>
</tr>
</tbody>
</table>

RFP#1084-13-RLJ PART C: Scope of Work and Specifications
<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Requirement Level</th>
<th>Standards Doc. (TIA-102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.5 kHz Channel Bandwidth</td>
<td>Mandatory</td>
<td>102A, BAAA-A</td>
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<tr>
<td>Freq Division Multiple Access (FDMA)</td>
<td>Mandatory</td>
<td>102A, BAAA-A, AABA-A</td>
</tr>
<tr>
<td>C4FM or CQPSK Modulation</td>
<td>Mandatory</td>
<td>102A, BAAA-A</td>
</tr>
<tr>
<td>9.6 kbps Gross Bit Rate</td>
<td>Mandatory</td>
<td>102A, BAAA-A</td>
</tr>
<tr>
<td>Backwards Compatibility (Analog FM)</td>
<td>Mandatory</td>
<td>102A, ANSI/TIA/EIA-603 Compliance</td>
</tr>
<tr>
<td>Data Interfaces (A and Ed)</td>
<td>Standard Opt.</td>
<td>102A</td>
</tr>
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<td>Feature Name</td>
<td>Requirement Level</td>
<td>Standards Doc. (TIA-102)</td>
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<tr>
<td>--------------------------------------------------</td>
<td>-------------------</td>
<td>--------------------------</td>
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<tr>
<td>SNMP</td>
<td>Standard Opt.</td>
<td>BAEB-A</td>
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<tr>
<td>SCEP</td>
<td>Standard Opt.</td>
<td>BAEB-A</td>
</tr>
<tr>
<td>SNDCP</td>
<td>Standard Opt.</td>
<td>BAEB-A</td>
</tr>
<tr>
<td>Telephone Interconnect</td>
<td>Standard Opt.</td>
<td>102A, BADA</td>
</tr>
<tr>
<td>FSI Fixed Station Interface</td>
<td>Standard Opt.</td>
<td>102A, BAHA, CADA</td>
</tr>
<tr>
<td>Tone Remote Control (TRC)</td>
<td>Standard Opt. Req.</td>
<td>BAHA, CADA</td>
</tr>
<tr>
<td>Intercom</td>
<td>Standard Opt.</td>
<td>BAHA, CADA</td>
</tr>
<tr>
<td>E&amp;M Signaling</td>
<td>Standard Opt.</td>
<td>BAHA, CADA</td>
</tr>
<tr>
<td>Digital IP Capabilities</td>
<td>Standard Opt. Req.</td>
<td>BAHA, CADA</td>
</tr>
<tr>
<td>Block Encryption</td>
<td>Standard Opt. Req.</td>
<td>BAHA, CADA</td>
</tr>
<tr>
<td>Talk group Information</td>
<td>Standard Opt. Req.</td>
<td>BAHA, CADA</td>
</tr>
<tr>
<td>NAC Information</td>
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<td>BAHA, CADA</td>
</tr>
<tr>
<td>Emergency Alert</td>
<td>Standard Opt. Req.</td>
<td>BAHA, CADA</td>
</tr>
<tr>
<td>Emergency Indications</td>
<td>Standard Opt. Req.</td>
<td>BAHA, CADA</td>
</tr>
<tr>
<td>Frequency of Operation Control</td>
<td>Standard Opt. Req.</td>
<td>BAHA, CADA</td>
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<tr>
<td>Repeating Voice Control</td>
<td>Standard Opt. Req.</td>
<td>BAHA, CADA</td>
</tr>
<tr>
<td>Repeating Squelch Control</td>
<td>Standard Opt. Req.</td>
<td>BAHA, CADA</td>
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<tr>
<td>Ethernet 100 Base-T w/RJ-45 connector</td>
<td>Standard Opt. Req.</td>
<td>BAHA</td>
</tr>
<tr>
<td>Received Voter Information</td>
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<td>BAHA, CADA</td>
</tr>
<tr>
<td>Intercom</td>
<td>Standard Opt.</td>
<td>BAHA, CADA</td>
</tr>
<tr>
<td>Group Voice Call</td>
<td>Mandatory</td>
<td>102A AABC-B, AABD</td>
</tr>
<tr>
<td>Individual Voice Call</td>
<td>Mandatory</td>
<td>102A AABC-B, AABD</td>
</tr>
<tr>
<td>Broadcast Voice Call</td>
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<td>102A, AABD</td>
</tr>
<tr>
<td>Discreet Listening</td>
<td>Standard Opt.</td>
<td>102A</td>
</tr>
<tr>
<td>Call Interrupt</td>
<td>Standard Opt.</td>
<td>102A</td>
</tr>
<tr>
<td>Announcement Group Call</td>
<td>Standard Opt.</td>
<td>AABC-B, AABD</td>
</tr>
<tr>
<td>System Call</td>
<td>Standard Opt.</td>
<td>AABC-B, AABD, CABA, BAAD</td>
</tr>
<tr>
<td>Feature Name</td>
<td>Requirement Level</td>
<td>Standards Doc. (TIA-102)</td>
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<tr>
<td>------------------------------------------</td>
<td>-------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Roaming</td>
<td>Mandatory</td>
<td>102A, AABC-B, AABD</td>
</tr>
<tr>
<td>Intra-System Roaming</td>
<td>Standard Opt.</td>
<td>102A, AABC-B, AABD</td>
</tr>
<tr>
<td>Inter-System Roaming</td>
<td>Standard Opt.</td>
<td>102A, AABC-B, AABD</td>
</tr>
<tr>
<td>Registration</td>
<td>Mandatory</td>
<td>102A, AABC-B, AABD</td>
</tr>
<tr>
<td>Authentication (Implicit)</td>
<td>Standard Opt.</td>
<td>AABC-B, AABD</td>
</tr>
<tr>
<td>Link Layer Authentication</td>
<td>Standard Opt.</td>
<td>AACE</td>
</tr>
<tr>
<td>Group Affiliation</td>
<td>Standard Opt.</td>
<td>102A, AABC-B, AABD</td>
</tr>
<tr>
<td>De-Registration</td>
<td>Mandatory</td>
<td>AABC-B</td>
</tr>
<tr>
<td>Block Audio Encryption</td>
<td>Standard Opt.</td>
<td>AAAD, AACA</td>
</tr>
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</table>

2.26.4  **Trunked** TIA-102 Features Matrix User List

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Requirement Level</th>
<th>Standards Doc. (TIA-102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AES Encryption of Voice</td>
<td>Standard Opt.</td>
<td>AAAD, AACA</td>
</tr>
<tr>
<td>AES Encryption of Packet Data</td>
<td>Standard Opt.</td>
<td>AAAD, AACA</td>
</tr>
<tr>
<td>Multiple Encryption Algorithms</td>
<td>Standard Opt.</td>
<td>AAAD, AACA</td>
</tr>
<tr>
<td>Multiple Encryption Keys</td>
<td>Standard Opt.</td>
<td>AAAD, AAAA-A</td>
</tr>
<tr>
<td>Encryption Key Update</td>
<td>Standard Opt.</td>
<td>102A</td>
</tr>
<tr>
<td>Over The Air Rekeying (OTAR)</td>
<td>Standard Opt.</td>
<td>102A, AACA, AACB, AACD</td>
</tr>
<tr>
<td>Manual Rekeying Features</td>
<td>Standard Opt.</td>
<td>102A, AACD</td>
</tr>
<tr>
<td>Call Alerting</td>
<td>Standard Opt.</td>
<td>102A, AABC-B, AABD, AABG, BACD</td>
</tr>
<tr>
<td>Short Data Messaging</td>
<td>Standard Opt.</td>
<td>102A, AABD, AABC-B, AABF-A, AABG, AABAA</td>
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<tr>
<td>Radio Unit Monitoring</td>
<td>Standard Opt.</td>
<td>102A, AABG, AABC-B, BACD</td>
</tr>
<tr>
<td>Emergency Alert/Alarm/Indication</td>
<td>Standard Opt.</td>
<td>102A, AABC-B, AABD, AABG, BACD</td>
</tr>
<tr>
<td>Emergency Group Call</td>
<td>Standard Opt.</td>
<td>BAAD, AABF-A</td>
</tr>
<tr>
<td>Radio Unit Inhibit*/Disable</td>
<td>Standard Opt.</td>
<td>102A, AABC-B, AABD, AABG</td>
</tr>
<tr>
<td>Feature Name</td>
<td>Requirement Level</td>
<td>Standards Doc. (TIA-102)</td>
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<td>--------------------------------------------------</td>
<td>-------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Radio Unit Uninhibit/Re-enable</td>
<td>Standard Opt.</td>
<td>102A, AABC-B, AABD, BACD</td>
</tr>
<tr>
<td>Radio Check</td>
<td>Standard Opt.</td>
<td>BAAD, AABF-A</td>
</tr>
<tr>
<td>Network Status</td>
<td>Mandatory</td>
<td>AABC-B, AABD</td>
</tr>
<tr>
<td>System Status</td>
<td>Mandatory</td>
<td>AABC-B, AABD</td>
</tr>
<tr>
<td>Channel Identifier</td>
<td>Mandatory</td>
<td>AABC-B, AABD</td>
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<tr>
<td>System Service</td>
<td>Standard Opt.</td>
<td>AABC-B, AABD</td>
</tr>
<tr>
<td>Adjacent Site Status</td>
<td>Standard Opt.</td>
<td>AABC-B, AABD</td>
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<tr>
<td>Secondary Control Channel</td>
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<td>AABC-B, AABD</td>
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<tr>
<td>Composite Control Channel</td>
<td>Standard Opt.</td>
<td>AABB0A, AABC-B, AABD</td>
</tr>
<tr>
<td>Backup Control Channel</td>
<td>Standard Opt.</td>
<td>AABC0B, AABD</td>
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<tr>
<td>Talking Party Caller Identification</td>
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<td>Call Restriction</td>
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<td>102A</td>
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<tr>
<td>Priority Call</td>
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<td>102A, AABC-B, AABD</td>
</tr>
<tr>
<td>Preemptive Priority Call</td>
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<td>102A</td>
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<tr>
<td>Call Routing</td>
<td>Standard Opt.</td>
<td>102A</td>
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<tr>
<td>Message Trunking</td>
<td>Standard Opt.</td>
<td>AABA-A</td>
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<tr>
<td>Transmission Trunking</td>
<td>Standard Opt.</td>
<td>AABA-A</td>
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<tr>
<td>CAI Common Air Interface</td>
<td>Mandatory</td>
<td>102A, BAAA-A</td>
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<tr>
<td>P25 Phase 1 IMBE Vocoder (Full Rate)</td>
<td>Mandatory</td>
<td>102A, BABA</td>
</tr>
<tr>
<td>12.5 kHz Channel Bandwidth</td>
<td>Mandatory</td>
<td>102A, BAAA0A</td>
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<tr>
<td>Frequency Division Multiple Access (FDMA)</td>
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<td>102A, BAAA-A, AABA-A</td>
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<tr>
<td>Time Division Multiple Access (TDMA)</td>
<td>Mandatory</td>
<td>102A, BBAA</td>
</tr>
<tr>
<td>Time Division Multiple Access (TDMA) PHY Layer</td>
<td>Mandatory</td>
<td>102A, BBAB</td>
</tr>
<tr>
<td>Time Division Multiple Access (TDMA) MAC Layer</td>
<td>Mandatory</td>
<td>102A, BBAC</td>
</tr>
<tr>
<td>C4FM or CQPSK Modulation</td>
<td>Mandatory</td>
<td>102A, BAAA-A</td>
</tr>
<tr>
<td>9.6 kbps Gross Bit Rate</td>
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<td>102A, BAAA-A</td>
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<tr>
<td>Backwards Compatibility (Analog FM)</td>
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<td>102A, ANSI/TIA/EIA-603</td>
</tr>
<tr>
<td>Compliance</td>
<td></td>
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</tr>
</tbody>
</table>
3 SPECTRUM PLANNING

3.1 System Spectrum Requirements

3.1.1 Central Puget Sound is a congested spectrum environment as a result of the large United State population in the region, as well as a similarly large population in lower British Columbia. Most spectrum resources are shared with Canada across all of King County. VHF and UHF spectrum for new assignments is exhausted entirely within the region, with 800 MHz also largely full assigned. The 700 MHz band is available for use, though many 700 MHz allocations have been made in the region. With these exceptions, this band remains available for use in building new systems.

3.2 Current Spectrum Environment in the Region

3.2.1 The radio systems supporting primary public safety communications in King and Snohomish Counties and the Tacoma metropolitan area are operating on 800 MHz spectrum. In most cases, these systems largely depend on NPSPAC channels, though there is also extensive use made of non-NPSPAC Public Safety Pool channels. These systems are all operating using Motorola proprietary SmartZone™ technology. A new 700 MHz P25 system is being deployed by Pierce County and Pierce Transit, with the Tacoma metro area also upgrading the existing Motorola SmartZone™ 4.1 system to P25 operation.

3.2.2 VHF users are limited to a small number of fire agencies, many State of Washington agencies, and federal government agencies. UHF users are limited to a number of public works radio systems, federal law enforcement and military radio systems and smaller counties to the north and west of King and Snohomish counties.

3.3 VHF Spectrum

3.3.1 The Owner makes limited use of VHF spectrum for interoperability purposes with agencies operating on VHF, as well as for search and rescue communications into remote areas of the county where the present level of development of the regional trunked radio systems prevents use of 800 MHz. A single VHF pair operated in a four (4) site repeated/simulcast/voted configuration is used as a component of the Mutual Aid Radio System (MARS). Another single VHF pair operated in a four (4) site repeated/simulcast/voted configuration is used for King County search and rescue (SAR) operations. The Owner also operates four (4) simplex simulcast/voted base stations on the Law Enforcement Radio Network (LERN).

3.4 UHF Spectrum

3.4.1 The Owner makes limited use of UHF spectrum for interoperability purposes with local and Federal agencies operating on UHF. A single UHF pair is used as a component of the King County Mutual Aid Radio System (MARS).

3.5 700 MHz Spectrum

3.5.1 The Region 43 Plan 700 MHz Plan provides guidance on the use of this spectrum. Proposers should be aware that the original county-by-county channel allotments have sunsetting and any unassigned and unlicensed channel may be used, provided appropriate engineering is performed as a part of the licensing process. Because of the availability of 700 MHz spectrum in the region, use of 700 MHz channels may be considered for both transitional or permanent purposes. None the less, Proposers are cautioned to use 700 MHz spectrum for permanent use...
only if absolutely required as part of the system design. Any proposal that requires permanent use of 700 MHz shall clearly explain the requirement or benefits to the Owner. 700 MHz spectrum is used by the King County Metro Transit trunked radio system. This system is unrelated to the requirements of this RFP.

3.6 800 MHz Spectrum

3.6.1 Given the availability of the significant spectrum resources at 800 MHz, combined with the efficiency inherent to migration to a TDMA “2:1” technology, the Owner desires to maintain use of 800 MHz spectrum resource as the primary spectrum choice for the new PSERN.

3.6.2 The Region 43 800 MHz Plan provides guidance on the use of this spectrum. Proposers should be aware that the original county-by-county channel allotments have sunssetted and any unassigned and unlicensed channel may be used, provided appropriate engineering is performed as a part of the licensing process.

3.6.3 Proposers should be aware that use of 700 MHz spectrum invokes RPC Region 43 requirements to deploy 700 MHz interoperability infrastructure, increasing the system cost as infrastructure must be added to the system design.

3.7 Microwave Spectrum

3.7.1 Extensive use of microwave connectivity is made by the Owner in and around King County. This connectivity is solely through FCC licensed spectrum. Proposer should be aware that the lower frequency microwave bands at 6 GHz and 10/11 GHz are heavily used and may be challenging to license. Proposers may choose to reuse existing licenses or establish new licenses as required for their specific system design.

3.8 FCC Licensing

3.8.1 Proposers are to provide, prepare, and submit all FCC applications required for the operation of the Proposed system. Proposers are also solely responsible for all engineering and engineering documentation required by frequency coordination entities and the FCC as it relates to FCC applications for the radio and microwave systems. Proposers should also be aware that FCC licensing shall be required for the primary trunked systems and the 700/800 MHz conventional interoperability repeaters. FCC licensing is not required for the VHF and UHF systems being updated as part of this RFP. All microwave systems proposed shall require licensing.

3.8.2 Proposers should carefully address spectrum planning in their Proposals and shall specify site-specific frequency data. Proposers are additionally cautioned that all radio and microwave system designs proposed must be licensable per Region 43 Plan, FCC Rule and meet all FCC power flux density limitations at and beyond the US-Canada border. Proposers should be aware that design that cannot be licensed in the region shall be rejected.

3.8.3 Proposal Frequency Plans shall include an initial IMD study for each site, with IMD calculations to only consider proposed frequencies. The final IMD Plan following detailed design shall include analysis of all existing and identifiable nearby emitters at each site, in addition to the newly proposed frequencies.

3.8.4 The Proposer shall be responsible for all RF interference mitigation and resolution related to the PSERN.
3.9 **800 MHz Rebanding in Region 43**

3.9.1 The Owner system is a part of Region 43. Because Region 43 is a border region with Canada, and because treaty negotiations delayed finalization of frequency planning in Region 43, Region 43 is presently in the midst of 800 MHz spectrum reconfiguration ("rebanding").

3.9.2 As a result, existing system channel data shall be shown both in terms of its present Region 43 and FCC assignments and in terms of its post-reconfiguration assignments. Proposers are cautioned that these channel assignments did NOT follow the non-border area channel change process where frequencies simply shifted downward 15 MHz. Because of the considerable complexities present in the region, channel assignments do not have a predictable structure and Proposers are cautioned to carefully investigate the spectrum data provided as technical exhibits to this RFP.

3.10 **FCC License Applications**

3.10.1 Proposer shall prepare any necessary licensing documentation, including any engineering documents or FCC Rule Waiver required, secure Owner signatures for all applications, and submit for regional coordination. Proposer shall present the application package to regional coordination bodies, including Region 43 and the Washington State SIEC, as well as any other local or regional approvals body. Once local coordination is completed, Proposer shall submit applications to national coordination bodies. All application and coordination costs shall be paid by Proposer.

3.10.2 Because the system is expected to require multiple years to design, manufacture, install, test and transition to, Proposer shall request Extended Implementation for all affected FCC licenses and shall have sole responsibility for annual Extended Implementation reporting to the FCC.

3.10.3 At the completion of the sixty (60) day system reliability test period, Proposer shall notify the FCC that construction is completed on all licensed radio and microwave radio systems and the requirements established by the FCC have been met.
4 LAND MOBILE RADIO SYSTEM

4.1 Technical Introduction

4.1.1 The Proposer shall offer a comprehensive multi-site trunked digital radio communications system design that shall provide, when compared to the current analog/digital mixed-mode trunked radio system technology deployed in King County, significantly enhanced capabilities. These include, but are not limited to, improved regional area coverage, enhanced operational features and expanded radio subscriber call loading, especially during critical events.

4.1.2 The proposed system shall conform to and support the Project 25 Common Air Interface (CAI) and implement both P25 Phase I (FDMA) and P25 Phase II (TDMA) trunked operation.

4.1.3 The Owner desires to fully exploit the inherent flexibility in the P25 FDMA control channel used in both Phase I and II trunked operation. The PSERN users expect to have the ability for the trunking system to validate FDMA and TDMA users assigned to a common talk group, falling back to Phase I (FDMA) operation when required for interoperability purposes. In addition, certain ‘patched’ conventional radio system resources may require that normal TDMA operation revert to FDMA operation. Further, communications traffic arriving over ISSI connections may also require FDMA operation. As a result, dual FDMA/TDMA mode system capability is required.

4.1.4 The Proposer shall describe the ability of their proposed system to support dynamic call management of mixed Phase I (single FDMA mode) and Phase II (dual FDMA/TDMA mode) subscribers in trunked operation. If not a standard feature of their Phase II (TDMA) solution, provide all cost information for including this capability.

4.2 LMR System Infrastructure Specifications

4.2.1 P25 Trunked Radio System Feature Set

4.2.1.1 TIA-102A defines a comprehensive suite of features and functionality provided within the P25 standard that includes supported call types, radio functionality, interoperability, inter-system linking and console interfacing under ISSI. The Owner expects to derive maximum benefit from the P25 standard by procuring a replacement radio system implementing the most comprehensive set of features afforded by the open standard.

4.2.1.2 The Proposer shall clearly detail any features or functionality defined under TIA-102A that they do not currently implement in their proposed solution and, if part of a future development roadmap, the expected availability of those features or functionality. Likewise, for Proposers that have implemented proprietary extensions or enhancements at the system, dispatch console, or radio subscriber level that exceed that supported by the TIA-102 standard, they shall fully disclose those implementations.

4.2.2 Radio Subscriber Roaming and Handoff

4.2.2.1 The system shall permit the user roaming across the entire area of coverage without requiring manual switching or changing of site
information. As a user moves through the system, the radio subscriber units shall employ software algorithms to automatically evaluate site signal strength and other characteristics to select the optimal site for affiliation and communications. The system shall track users as they move through the network and direct their calls to the site providing the best coverage to the area where the user is located.

4.2.3 Roaming Optimization of Radio Subscriber Units

4.2.3.1 Radio Subscriber units shall have configurable parameters allowing optimization of roaming characteristics based upon control channel signal level or Bit-Error-Rate (BER). Preferred site or geography based site subscriber affiliations shall be configurable. Proposer is fully responsible for field optimization of their offered radio subscriber unit’s roaming characteristics at time of system commissioning. This includes the roaming characteristics for subscriber equipment manufactured by the Proposer and provided subscriber equipment of other manufacture.

4.2.3.2 The Proposer shall, as part of required Owner technical training, provide detailed hands-on programming instruction on roaming optimization of radio subscriber units to include roaming theory of operation, configurable parameters and effects on roaming characteristics based on software/programming settings and the topography of the proposed PSERN.

4.2.4 Restriction of Talk groups to Geographic Areas

4.2.4.1 The system shall permit talk groups to be restricted to specific sites and to specific radio channels at a site. This feature permits talk groups to be limited to specific geographic areas. It also permits the segregation of different user classes at a site. The Proposer shall detail the method(s) implemented at the system and subscriber unit level to accomplish this feature.

4.2.5 Radio Inhibit

4.2.5.1 TSB 102.AABD describes the “Radio Inhibit” and “Radio Un-Inhibit” functionality for subscriber units. In the inhibited condition, the radio subscriber unit shall blank any User display device(s) and there shall be no indication, visual or audible, of operational conditions of the radio to the user. The radio shall ignore all user or other external inputs. The proposed system shall, via a dispatch console and network management client, support the Radio Inhibit as outlined in the standard. The Owner desires to have the ability to selectively enable or disable an individual radio subscriber unit from the system management computer, remote administrator access, as well as a line-connected dispatch console with appropriate administrator log-in privileges.

4.2.5.2 If the proposed system and radio subscribers support multiples levels of radio subscriber impairment or has implemented enhancements beyond the TSB 102.AABD defined functionality via remote interrogation, please provide details of this capability.
4.2.6 Push-to-Talk Radio Identification (PTT ID)

4.2.6.1 The radio ID shall be included in each transmission. The system shall display the radio ID on its associated talk group in the console at the Dispatch Center. Suitably equipped mobile and portable radios shall be able to display the calling unit ID for both individual and group calls. Each mobile radio, portable radio, control station, and dispatch console shall be capable of displaying an alphanumeric alias corresponding to the unit ID, if available from the transmitting device.

4.2.7 System Access by Unauthorized Voice or Data Radios

4.2.7.1 The system shall prevent access by unauthorized voice or data radios. The Proposer shall outline all methods used to implement this capability and the relative level of security provided by each method.

4.2.7.2 Proposer shall specifically outline methods used to locate and identify “cloned” radios (with otherwise valid individual ID and Talk Group IDs) on the system and preventing their future access and operation. Radio network access restrictions shall include closed system databases, methods of controlling radio programming using systems keys or other means of controlling radio programming, and any methods by which subscriber radios from other manufacturers may be prevented from accessing the PSERN. Proposers shall disclose their implementation of the P25 TIA 102.AACE Link Layer Authentication standard, if applicable.

4.2.8 Over-The-Air Provisioning (OTAP)

4.2.8.1 This function is highly desired by the Owner and shall be included in Proposer’s proposals. As of the writing of this document, the Owner understands that TIA TR8 has not finished establishing a TIA standard for the Over-The-Air Provisioning (OTAP) feature. Therefore in the absence of an “open standard” for OTAP, the Owner requests that Proposers disclose what specific OTAP features and functionality are included with the understanding that their implementation may be proprietary or Proposer-specific. Proposers are encouraged to disclose their expected implementation of OTAP and provide this at a later date or upon TR8 final release of OTAP standard.

4.2.8.2 The Owner desires OTAP capability to provision radio parameters to mobile and portable subscriber radios over the air (without the need to physically connect the radio programmer to the radio). Ideal provisioning would include the supply of system information such as available radio channels, and user specific information such as talk group lists, scan priorities and user privileges.

4.2.8.3 Proposers shall disclose Estimated OTAP “push times” to perform a radio template update to a single (qty. 1), small group (qty. 100) or fleet (qty. 1000) of subscriber radios

4.2.8.4 Proposers shall disclose the requirement for OTAP “push” to utilize control channel only, or option of utilizing a working channel within a trunked system for this purpose.
4.2.8.5 Proposers shall disclose the additional or optional hardware and/or software needed to add OTAP capability to infrastructure, to include cost.

4.2.8.6 Proposers shall disclose the additional or optional hardware and/or software needed to add OTAP capability to radio subscriber units, to include cost.

4.2.8.7 Proposers shall disclose optional manual or automated approaches to implement OTAP off-system, Examples include the use of 802.11 (Wi-Fi) or 4.9 GHz point-to-multipoint wireless access points, commercial carrier wireless (cellular) data systems or other implementations not requiring the physical presence of a radio system technician at the radio subscriber unit to implement the programming “push”

4.2.8.8 Proposers shall disclose any future OTAP features and/or functionalities planned and expected implementation dates.

4.2.8.9 Proposers shall disclose their commitment to develop a plan to bring the system and subscriber equipment into compliance with the OTAP standard once it is adopted.

4.3 System Network Infrastructure Requirements

4.3.1 Wide Area Trunked System Controller Redundancy

4.3.1.1 Redundant Trunked System Controllers shall be proposed. A minimum of two controllers shall be provided, located at facilities that offer optimum system connectivity, reasonable maintenance access and well-designed operating environments that provide adequate physical space, suitable environmental conditions and adequate protection against known hazards (loss of power, seismic risks, proximity to environmental hazards, etc.). Each controller shall also be fully redundant at each of the two or more locations.

4.3.1.2 Proposers shall recommend locations for trunked system controllers in their Proposal to this RFP. System architectures that provide for greater levels of redundancy in critical control equipment shall be viewed as beneficial in the evaluation process. Proposed solutions offering greater levels of redundancy shall highlight these capabilities in the Proposer’s Proposal.

4.3.2 Wide Area Trunked System Controller

4.3.2.1 The system proposed shall include wide area trunked system controller functionality that generally provides for intelligent system interconnection of P25 trunked radio sites, dispatch consoles, and P25 data network to form a fully integrated radio system supporting wide area voice and data communications. The interconnection of system elements includes internal, as well as external radio system resources.

4.3.2.2 Trunked System Controller Internal Resources

4.3.2.2.1 Common conventional and trunked P25 systems control

4.3.2.2.2 Local and remote dispatch console systems

4.3.2.2.3 Simulcast and multicast subsystems
4.3.2.2.4 Conventional radio systems, including both legacy systems and interoperability resources
4.3.2.2.5 Logging recorder systems (provide as priced option)
4.3.2.2.6 System management hardware and systems
4.3.2.2.7 Trunked System Controller External Resources
4.3.2.2.8 Legacy Motorola proprietary trunking systems
4.3.2.2.9 Legacy conventional and P25 trunked radio systems
4.3.2.2.10 New P25 conventional radio systems
4.3.2.2.11 Other wide area controllers through the ISSI interface

4.3.3 Proposers are cautioned that no specific wide area controller architecture is required of Proposers. Instead, the Owner requires high system availability and geographic redundancy through split site central control equipment or fully distributed control architecture. The mechanism by which these capabilities are achieved by the Proposers system design should be clearly identified in the Proposal. Wide area controller architectures that depend on highly dispersed system control should describe that functionality and how databases are managed in such a configuration.

4.3.4 In all Proposals, a minimum of two geographically separated controllers shall be proposed, with each located at facilities that offer optimum system connectivity, reasonable maintenance access and well-designed operating environments that provide adequate physical space, suitable environmental conditions and adequate protection against known hazards (loss of power, seismic risks, proximity to environmental hazards, etc.).

4.3.5 The wide area controller shall manage and track each Project 25 trunked radio and its affiliated talk group as it roams throughout the coverage area of the PSERN. The wide area controller shall route calls to individuals or groups at the appropriate sites and conserve resources at sites not required to support the active radio call.

4.3.6 Unless otherwise configured, mobile or portable radios shall be de-registered from a site when it registers onto a new site, or is turned off. Less desirable is de-registration after a programmable period of inactivity. Proposers shall describe the de-registration process for the subscribers they are proposing and for subscribers from other manufacturers.

4.3.7 It is expected that the trunked system and site controllers will normally be rotated automatically on a monthly basis in order to maintain readiness to shift all system operations between controllers if so required. Systems that provide greater levels of distributed control may be viewed as more beneficial in the evaluation process. Proposers offering greater levels of redundancy should clearly identify these capabilities.

4.3.8 Wide Area Controller Reversion
4.3.8.1 Regardless of system configuration proposed, the wide area controller shall update all remote elements of the system such that a complete active controller failure or system manager initiated controller rollover has a minimal impact on system operation. The network bandwidth or
data payload requirements to accomplish this update shall be disclosed in terms of committed information rate in kbps.

4.3.8.2 The inactive wide area controller shall be capable of taking over full system control in less than sixty (60) seconds after the active wide area controller unit has lost system connectivity or has failed. Any loss of voice or data communications shall be limited to the interval from the failure of the active wide area controller to the time the previously inactive wide area controller assumes full system control. Remote sites should re-integrate with the wide area control system in the minimal practical time. Proposers shall state the time required for their proposed system architecture to return to complete wide-area operation following loss of control of the central control element.

4.3.8.3 Complete control over the wide area controller shall only be provided to authorized staff through the system management system. The wide area controller equipment shall be powered from -48VDC. Proposers shall specify current requirements.

4.4 Simulcast Transmission Systems

4.4.1 The Owner believes simulcast operation is required to provide reliable wide-area coverage for the region, in part due to spectrum availability requirements and in part based on the improved area and in-building coverage performance available with simulcast/voted system operation.

4.4.2 Any proposed system design that uses simulcast technology shall be a GPS/atomic clock synchronized digital simulcast system with launch time control using time stamped outbound signaling to the remote simulcast sites, and shall use IP transport. The system shall be capable of automatically adjusting the path delay of interconnections utilized in the system to compensate for any change in system configuration, including mesh rerouting, loop reversal or other alternate path selection.

4.4.3 Simulcast systems as proposed shall be sized to allow both for the initially required number of sites and added future sites up to a maximum of five additional sites per simulcast subsystem. Any hardware or software limitations on the total number of simulcast sites per simulcast subsystem shall be clearly identified in the Proposal.

4.4.4 Proposers shall describe fully the trunked simulcast system architecture where proposed and shall provide descriptions of all major system components and their functions. System block diagrams shall be provided to show system and site configurations.

4.5 Receiver Voting Systems

4.5.1 All simulcast subsystems shall be provided with receiver voting capabilities. Voting systems as proposed shall be sized to allow both for the initially required number of sites and added future sites up to a maximum of five additional sites per simulcast subsystem. Any hardware or software limitations on the total number of voting receivers per simulcast subsystem shall be clearly identified in the proposal.

4.5.2 The proposal shall clearly detail how the proposed voting system functions. Proposers shall describe fully the voting system architecture where proposed, and shall provide descriptions of all major system components and their functions. System block diagrams shall be provided to show system and site configurations.
4.6 Simulcast Site Controllers

4.6.1 Redundant simulcast site controllers are required at each simulcast “master” site (a site that provides database management and other services to a cluster of connected simulcast RF sites). System architectures that provide for greater levels of redundancy in critical control equipment shall be viewed as beneficial in the evaluation process. Designs for splitting of receiver voting and simulcast control elements between two or more geographically separated sites shall be described fully and proposed. Proposers offering greater levels of redundancy should identify these capabilities. All equipment shall be provided with alarm outputs as required to deliver status information to the network monitoring system.

4.7 Simulcast Trunking Site Controllers

4.7.1 Redundant simulcast site controllers are required at each simulcast RF site (a site that is part of a group of simulcast sites, each operating under control of the simulcast site controller at the simulcast cell “master” site). System architectures that provide for greater levels of redundancy in critical control equipment shall be viewed as beneficial in the evaluation process. Proposers offering a greater level of redundancy should identify these capabilities. All equipment shall be provided with alarm outputs as required to deliver status information to the network monitoring system.

4.8 Multicast trunking Site Controllers

4.8.1 Redundant multicast site controllers are required at each multicast (non-simulcast RF) site. System architectures that provide for greater levels of redundancy in critical control equipment shall be viewed as beneficial in the evaluation process. Proposers offering greater level of redundancy should identify these capabilities. All equipment shall be provided with alarm outputs as required to deliver status information to the network monitoring system.

4.9 Simulcast Optimization Equipment

4.9.1 Proposers shall include in their proposal any systems or test equipment required for simulcast optimization. The Proposer, as part of their required system training to the Owner, shall provide detailed technical training to the Owner’s technical staff on simulcast optimization. It shall include as a minimum, the following:

   4.9.1.1 Simulcast theory of operation
   4.9.1.2 Simulcast design and performance differences between analog and P25 digital radio systems
   4.9.1.3 Overview of system components essential to simulcast operation
   4.9.1.4 Simulcast optimization techniques and troubleshooting methods to ensure proper simulcast performance to include use of required or recommended test equipment

4.10 Radio System Network Management and Diagnostic System

4.10.1 The proposed system management system shall be integrated into the trunked system wide area controller system, and shall be based on a client/server architecture and common database for all system management functions.

4.10.2 Proposers shall include system management terminals to be installed at the locations specified in Table 4.10.
<table>
<thead>
<tr>
<th>Location of Provided Network Management Terminal</th>
<th>Qty. Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trunked System Controller Location X</td>
<td>2</td>
</tr>
<tr>
<td>Trunked System Controller Location Y</td>
<td>2</td>
</tr>
<tr>
<td>EPSCA Office</td>
<td>2</td>
</tr>
<tr>
<td>Seattle Radio Shop</td>
<td>2</td>
</tr>
<tr>
<td>King County Radio Shop</td>
<td>2</td>
</tr>
<tr>
<td>Valley Comm</td>
<td>2</td>
</tr>
<tr>
<td>SEA Fire, SEA PD</td>
<td>2</td>
</tr>
<tr>
<td>KCSO Dispatch</td>
<td>2</td>
</tr>
</tbody>
</table>

**Table 4.10 System Management Terminal Quantities and Locations**

4.10.3 The system management terminal shall be capable of providing integrated system management of the entire system, including the radio system infrastructure and console systems. Integration of external systems including microwave and MPLS network, all sites alarms and subsystem alarms is desired. The ability to provide secure remote connection of technician laptop computers as system management consoles is required. The Owner prefers to have network management client software reside locally on individual workstations rather than server based for better acquisition of real-time data.

4.10.4 The system shall be capable of supporting multiple network management consoles, including technician laptop computers, operating concurrently at different locations within the wide area network, without degradation of network management console performance. The system management computer and consoles shall be powered from 120 VAC 60 Hz. Proposers shall specify their current hardware and operating system requirements for technician laptops.

4.11 System Management Capabilities

4.11.1 Owner is seeking system management capabilities that will assist in managing system-wide elements efficiently. These resources include the ability to deliver system, site and external equipment alarms through a harmonized system that consolidates data and allows remote control over system components. This capability might be at central locations such as the radio shops or at each radio site. Additionally, the ability to remotely manage system elements from secure laptop computers is required, as is the ability for the system to send e-mails and/or text messages with alarm information to cellular phones and pagers.

4.11.2 The Proposer shall offer this as an integrated system as a priced option.

4.11.3 The following are required capabilities for the core system:

4.11.3.1 System Management Workstations

4.11.3.2 Support for minimum of ten (10) concurrent connections from local or remotely connected workstations.

4.11.4 System Element Polling and Alarming

4.11.4.1 The system management computer shall support element polling and alarming. System devices and elements that detect a changed status or are operating with abnormal conditions shall automatically transmit an alarm to the system management system. The system management computer shall automatically and routinely poll system devices to determine status. Element failure that completely prevents the
transmission of an alarm shall be detected through polling. The management system should be capable of determining status of external devices and systems, including microwave, power system and remote site alarms, which are not managed directly.

4.11.5 System Alarm SNMP Integration

4.11.5.1 The Alarm System shall incorporate a Network Management System (NMS) that is capable of integration with third-party SNMP based NMS products for alarm purposes and provide alarm detail information.

4.11.5.2 Minimum alarm generated notifications to technicians from the NMS shall include:

4.11.5.2.1 E-mail message with descriptive information (preferably) and alarm code number

4.11.5.2.2 Text message (SMS) with descriptive information (preferably) and alarm code number to commercial wireless (cellular) device

4.11.6 Network Element Map

4.11.6.1 The management system shall provide a graphical system map display, showing all managed devices using color coding to represent device status or failed condition. Through the system map it shall be possible for the operator to determine the current detailed status of a managed object.

4.11.7 Fault Browser

4.11.7.1 The management system shall provide a scrollable, time sorted list of alarm messages sent by managed system elements.

4.11.8 Audible Alert

4.11.8.1 The management system workstation shall provide a programmable audible alert to notify technicians of changes in the system status.

4.11.9 System Security and Data Base Partitioning

4.11.9.1 The system management function shall be protected from intrusion by unauthorized users, while allowing remote access through VPN or other secure access method. The system shall be capable of partitioning the database such that different managers and organizations have control only over selected system elements, radio units and groups for which they have been authorized. The system management function shall have multiple levels of security access and keep a log of all entries into the system by date, time, and authorized individual.

4.11.10 System Element and User Radio Administration

4.11.10.1 The management system shall support establishing and updating repeater site parameters, and remotely enabling and disabling radios, as well as supporting the provisioning and registration of new voice and data users in the system. The ability to support subscriber changes via external data file management through the use of spreadsheet tool
utilizing common import/export files types (ex. csv, xls., etc.) is highly desirable.

4.11.11 System Level Logging and Statistics

4.11.11.1 This capability shall allow for the determination of the relative traffic loading for each element of the system. The system management function shall maintain an electronic record of all activity for a period of thirty (30) to sixty (60) days, with electronic files capable of being downloaded to permanent raw-data storage media. This raw data shall be recoverable and an application provided that allows viewing and analysis of the data regardless of its age. All data shall have the capability to be easily downloaded, preferably by automated means, to a common database or spreadsheet format.

4.11.11.2 The system management function shall be able to continue to log site activity when a report is being run or when downloading to the supported storage media.

4.11.11.3 The system level logging capability shall collect and save the following statistics for later analysis:

4.11.11.3.1 Data and voice traffic volume by site with a minimum time granularity of ten minutes
4.11.11.3.2 Data and voice traffic volume by repeater with a minimum time granularity of ten minutes
4.11.11.3.3 Wide area controller data and voice traffic volume with a minimum time granularity of ten minutes
4.11.11.3.4 Usage time for each channel at a site
4.11.11.3.5 Comparative utilization by site
4.11.11.3.6 The number of minutes by site that all of the channels at the site are busy to include the duration, date and time.

4.11.11.4 Features that provide a date/time stamp for logging shall be synchronized to a common time source.

4.11.12 User Radio Logging and Statistics

4.11.12.1 The system proposed shall provide call activity logging. This capability shall allow for the determination of the relative traffic loading and geographic distribution for each of the talk groups and individual users active on the system. The system management function shall maintain an electronic record of all voice call activity for a period of up to sixty (60) days, with electronic files capable of being downloaded to permanent raw-data storage media. This raw data shall be recoverable and an application provided that allows viewing and analysis of the data regardless of its age. All data shall have the capability to be easily downloaded to common database or spreadsheet formats.

4.11.12.2 The system management function shall be able to continue to log active call traffic when a report is being run or when downloading to the supported storage media.
4.11.12.3 The following data should be stored as a minimum:

4.11.12.3.1 Date, time, and duration of call
4.11.12.3.2 Type of call (group, private call, emergency)
4.11.12.3.3 Radio ID initiating call and talk group number
4.11.12.3.4 Radio ID initiating call and target unit number
4.11.12.3.5 Repeaters and dispatch consoles participating in the call
4.11.12.3.6 Features that provide a date/time stamp for logging shall be synchronized to a common time source.

4.11.13 Remote Diagnostics

4.11.13.1 The system management function shall permit the operator to run remote diagnostics on all operationally significant system elements and devices to isolate and troubleshoot faults.

4.11.14 Site Alarms

4.11.14.1 The system shall be capable of detecting the failure or impaired operation of all major equipment items at the repeater site, including at a minimum:

4.11.14.1.1 High SWR/low transmitter power alarms
4.11.14.1.2 Trunked site controller operation
4.11.14.1.3 Link status
4.11.14.1.4 Antenna system condition
4.11.14.1.5 Tower top amplifier status (if present), pre-amplifier, or receiver multicouplers
4.11.14.1.6 Tower lighting operational status
4.11.14.1.7 AC power fail and generator status/alarms
4.11.14.1.8 Fuel levels (day tank and fuel tank) of site generators
4.11.14.1.9 Voltage and Current readings
4.11.14.1.10 Failure and status data from the site DC power system
4.11.14.1.11 Failure and status data from 120 VAC inverter system
4.11.14.1.12 Site temperature, fire, HVAC system alarms and intrusion alarms
4.11.14.1.13 Other remote site alarms as required by the system design
4.11.14.1.14 Any equipment utilizing a date/time stamp for alarm logging shall be connected to the system timing resource.

4.11.15 Off-Air System Trunked System Monitoring

4.11.15.1 The system shall provide the capability for off-air monitoring of site status and trunked system assignments from each control channel. This capability shall be able to be remotely operated over the Owner
network for facilities that are unable to deliver adequate off-air signal to Owner radio shops. Proposers shall propose off-air monitoring capability for all trunked system elements with monitoring equipment provided for each proposed trunked system site (simulcast systems are to be treated as a single site). Proposers shall include all required computers (if used), as well a mechanism by which system managers and technicians may remotely access the system off-air data.

4.12 Base Station/Repeater Infrastructure General Requirements

4.12.1 All trunked system repeaters shall be configured for APCO P25 Phase I (FDMA) and Phase II (TDMA) CAI operation. All repeaters shall be capable of being configured as either a Project 25 control channel or traffic channel supporting dynamic switching of FDMA and TDMA operation, and up to four (4) of the traffic channel repeaters at a single site shall be capable of automatically assuming the role of the control channel in the case of a failure of the control channel repeater.

4.12.2 All conventional base station/repeaters shall be configured for both analog and APCO P25 Phase I (FDMA) CAI operation, with the exception of 700 MHz base station/repeaters where operation shall be limited to P25 Phase I (FDMA).

4.12.3 All proposed base station equipment shall be powered by -48 VDC common battery systems.

4.12.4 Base stations/repeaters that are used in a simulast configuration shall include provision for external frequency reference input from frequency and timing standards present at each radio site.

4.13 Remote Repeater Provisioning and Management

4.13.1 The proposed base stations shall be controlled and managed through the system management network, servers and workstations. The system shall provide the ability to reconfigure individual repeaters through the network backhaul interface. Proposers shall indicate the extent to which repeater parameters can be configured remotely, and whether this programming is restricted to repeater parameters or also includes repeater operating system software. Desired capabilities for site management include the following as a minimum:

4.13.1.1 Deactivating individual channels and repeaters
4.13.1.2 Disabling repeater function for simulcast sites
4.13.1.3 Downloading and uploading repeater operating parameters
4.13.1.4 Downloading repeater firmware
4.13.1.5 Intelligent, automated adjacent site base station reconfiguration during simulcast operation upon the loss of any base station to eliminate unmanaged unsynchronized overlap.

4.14 Physical and Environmental Specification

4.14.1 The Project 25 trunked repeater stations, including repeater and station channel controller, shall be housed in standard 19" EIA racks, with six stations (or more) per rack to conserve space, and all equipment shall meet the following minimum requirements:

4.14.1.1 The equipment shall operate over a temperature range of –30° to +60°C
4.14.1.2 The repeater shall be of an architecture that provides for field replaceable units (FRU)

4.14.1.3 The repeaters shall meet or exceed all applicable FCC requirements

4.14.1.4 All proposed stations shall fully comply with EIA requirements as they apply to both analog stations and P25 stations

4.14.1.5 The stations shall meet or exceed TIA-102 and TIA 603 “Class A” base station transmitter and receiver specifications

4.14.1.6 Repeaters shall provide automatic call sign identification that meets FCC requirements

4.14.1.7 Alarm outputs as required to deliver status information to the network monitoring system
4.15 Base Station Transmitter Specifications

4.15.1 The proposed base station/repeater transmitter performance shall meet or exceed the following specifications:

<table>
<thead>
<tr>
<th><strong>700/800 MHz BASE STATION TRANSMITTER PERFORMANCE SPECIFICATION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency Range (MHz)</strong></td>
</tr>
<tr>
<td><strong>Channel Spacing</strong></td>
</tr>
<tr>
<td><strong>RF Power Output</strong></td>
</tr>
<tr>
<td><strong>Frequency Stability (-30 ~ +60°C)</strong></td>
</tr>
<tr>
<td><strong>Modulation Deviation (kHz)</strong></td>
</tr>
<tr>
<td><strong>Analog FM Hum and Noise (dB)</strong></td>
</tr>
<tr>
<td><strong>Audio Response (dB)</strong></td>
</tr>
<tr>
<td><strong>Spurious and Harmonic Emission Attenuation (dB)</strong></td>
</tr>
<tr>
<td><strong>Analog Audio Distortion</strong></td>
</tr>
<tr>
<td><strong>Modulation Fidelity (%)</strong></td>
</tr>
<tr>
<td><strong>Intermodulation Attenuation (dB)</strong></td>
</tr>
<tr>
<td><strong>P25 Adjacent Channel Power (dBc)</strong></td>
</tr>
</tbody>
</table>

*Table 4.15 Base Station Transmitter Performance Specification*
4.16  **Base Station Receiver Specification**

4.16.1  The base station/repeater receiver performance shall meet or exceed the following specifications:

<table>
<thead>
<tr>
<th><strong>700/800 BASE STATION RECEIVER PERFORMANCE SPECIFICATION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency Range (MHz)</strong></td>
</tr>
<tr>
<td><strong>Channel Spacing (kHz)</strong></td>
</tr>
<tr>
<td><strong>Analog Sensitivity for 12 dB SINAD ( dBm)</strong></td>
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<tr>
<td></td>
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<tr>
<td><strong>P25 Reference Sensitivity @ 5% bit error rate (dBm)</strong></td>
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<tr>
<td></td>
</tr>
<tr>
<td><strong>P25 Adjacent Channel Rejection @ 12.5 kHz (dB)</strong></td>
</tr>
<tr>
<td><strong>Analog Adjacent Channel Rejection @ 12.5 (dB)</strong></td>
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<tr>
<td></td>
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<tr>
<td></td>
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<tr>
<td><strong>Selectivity (dB)</strong></td>
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<tr>
<td></td>
</tr>
<tr>
<td><strong>Intermodulation Rejection (dB) @ 12.5 kHz</strong></td>
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<tr>
<td><strong>Spurious and Image Rejection (dB)</strong></td>
</tr>
<tr>
<td><strong>Analog FM Hum and Noise (dB)</strong></td>
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<tr>
<td></td>
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<td><strong>Frequency Stability (-30 ~ +60°C)</strong></td>
</tr>
<tr>
<td><strong>Analog Audio Response</strong></td>
</tr>
<tr>
<td><strong>Analog Audio Distortion</strong></td>
</tr>
</tbody>
</table>

**Table 4.16 Base Station Receiver Specification**

4.17  **Radio Site Antenna Systems**

4.17.1  All repeater antenna and feed line configurations shall be designed to provide the specified coverage, while simultaneously meeting the requirements established by the FCC, Region 43 Plan(s) and other design constraints. Proposers should be fully aware that tower space and structural loading is limited at many of the Owner facilities and Proposers are cautioned that any proposed site redesign shall require attention to these limitations. The Owner has generally assumed 1-5/8" transmit cables for 700/800 MHz systems at all taller towers (total cable runs in excess of 100’) and 7/8" cables for shorter towers (total cable runs of under 100’) or where constrained by cable pathway limitations.
4.18 Lightning Protection

4.18.1 All VHF, UHF and 700/800 MHZ radio system components shall be provided protection from direct or indirect lighting strikes through the use of in-line lightning surge suppression technology on transmission line coaxial cables.

4.18.2 The proposer shall specify the appropriate transient suppression technology for each RF sub-system component to be protected, based upon frequency range, transient response time and electrical circuit design, such as:

4.18.2.1 Gas Tube (DC block or DC open)
4.18.2.2 \( \frac{1}{4} \lambda \) Wave Stub (with or without gas tube)
4.18.2.3 Broadband High Pass Filter (DC block or DC open)

4.19 Receiver Tower Top Amplifier (TTA)

4.19.1 Good engineering design takes into account a balanced system with talk-in and talk-out coverage. The use of tower top amplifiers at sites with taller towers in order to improve system noise figure and provide balanced operation shall be at the discretion and recommendation of the Proposer. The use of DC bias (power) injectors for powering TTA via receive feedline is required, as is provision of a TTA test signal feedline. TTA configurations shall be inherently fault tolerant and include hybrid coupled amplifiers in their design. Suitable window filters shall be supplied internal to the TTA to reject out-of-band RF signals. The TTA equipment proposed shall provide suitable alarm outputs to indicate impaired operation or failure to the proposed network monitoring system. Engineering data as part of the system design shall be provided to validate the necessity or benefit from the potential use of a tower-top amplifier.

4.20 Receiver Multicoupler Equipment

4.20.1 All sites shall be equipped with rack mounted receiver multicouplers. These shall be of an expandable design supplied with the number of ports specified, plus a minimum of four additional expansion ports, with all unused ports terminated with 50 \( \Omega \) impedance resistive terminations. Suitable window filters shall be supplied with the multicoupler to reject out-of-band RF signals. All receiver multicoupler equipment proposed shall provide suitable alarm outputs to indicate impaired operation or failure to the proposed network monitoring system. Proposers shall specify the coaxial lightning arrestors required to power any equipment via the receive transmission line.

4.21 Transmitter Combining Equipment

4.21.1 Transmitter combiners shall be rack mounted in EIA open racks with sufficient space available to expand to the number of combined channels by at least two channels at each site as may be required for future system growth. All combiners should be specified such that their design offers the lowest achievable losses based on the Proposer Frequency Plan. All proposed combining systems shall be designed around the available spectrum resources.

4.22 Transmitter Power Output Monitoring (FDMA, TDMA and Analog Stations)

4.22.1 The Proposer shall include transmitter power output and reflected power monitoring systems for each supplied base station. The measurement points shall include forward and reverse power from each transmitter, as well as forward and reverse power from the output of each transmitter combiner.
4.22.2 Where multiple combiners are bridged, composite forward and reflected power output data shall be measured at the output of the joined combiners. Power measurements shall include both average and peak power data. All forward and reverse power levels shall be able to be monitored at the transmitter location. Power level data shall also be available to Field Activities Managers using remote access to the site power data. It is also desirable to have transmitter power data delivered to the radio system central network management system (NMS).

4.23 PIP and PIM Rated Components

4.23.1 All Proposed transmitter combiner, antenna systems and related components shall be properly rated for the high PIP (Peak Instantaneous Power) levels present in the transmitted TDMA signal.

4.23.2 All Proposed receive chain components, transmitter combiner, antenna systems and related components shall be specified as having the lowest available PIM (Passive Inter Modulation) ratings for the specified product type.

4.24 VHF/UHF System General Requirements

4.24.1 Proposers shall replace the existing conventional VHF and UHF interoperability radio systems operated by Owner with new analog narrowband radio equipment. This shall be a like-for-like infrastructure replacement, including replacement of existing antenna systems, for each of the following systems:

4.24.1.1 VHF F1 (simulcast repeated channel pair with voting) 155.190 MHz/154.650 MHz with voted receive with transmit and receive sites located at Sobieski Mountain, Rattlesnake Mountain, Squak Mountain, and Top Hat

4.24.1.2 UHF (simulcast repeated channel pair with voting) 460.550 MHz in /465.550 MHz in with voted receive with transmit and receive sites located at Sobieski Mountain, Rattlesnake Mountain, Squak Mountain, and Top Hat

4.24.1.3 800 MHz trunked system talkgroup (this talkgroup is delivered to all major trunked system sites)

4.24.1.4 Law Enforcement Radio Network (LERN) 155.370 MHz simplex base station

4.24.1.5 Simulcast simplex bases with voted receive with transmit and receive sites located at Sobieski Mountain, Rattlesnake Mountain, Squak Mountain, and Top Hat

4.24.1.6 King County Search and Rescue F2 154.965 MHz out /153.995 MHz in VHF (simulcast repeated channel pair with voting) with voted receive with transmit and receive sites located at Sobieski Mountain, Rattlesnake Mountain, Squak Mountain, and Top Hat

4.25 Performance Requirements

4.25.1 Demonstration of the proper operation of these systems shall be a required element of both factory and field testing. However, while the expected coverage performance of the conventional Interoperability system shall be shown in Proposer provided maps, the provided maps shall be used by Owner for informational purposes only. No Coverage Acceptance Testing shall be performed on these systems.
4.26  **700/800 Conventional Interoperability General Requirements**

4.26.1 The PSERN project shall include the redevelopment of the existing 800 MHz conventional mutual aid repeater systems that are a part of the present Owner regional system. These stations shall be replaced with new equipment of the same type as to be supplied for the new PSERN.

4.26.2 The Owner deployed a network of conventional mutual aid/interoperability repeaters using the national calling and tactical operations frequencies at the time the present Motorola 4.1 SmartZone™ system was installed. The network of 800 MHz analog conventional interoperability repeaters includes stand-alone repeaters on each of the frequencies noted below.

4.26.2.1 8CALL90 (formerly ICALL) at Squak Mountain in central west King County

4.26.2.2 8TAC91 (formerly ITAC-1) at Cambridge in south west King County

4.26.2.3 8TAC92 (formerly ITAC-2) at Horizon Heights in Bellevue

4.26.2.4 8TAC93 (formerly ITAC-3) at Capitol Hill in Seattle

4.26.2.5 8TAC94 (formerly ITAC-4) at Crista in North West King County

4.26.2.6 King County Metro Transit placed into operation a 700 MHz P25 conventional repeater when it brought its Motorola X2 trunked radio system on-line. This repeater is monitored at the Metro Transit dispatch center.

4.26.2.7 7CALL operated by King County Metro Transit at Squak Mountain in central west King County

4.27  **8CALL90 Simulcast Network Requirement**

4.27.1 As part of the PSERN, the 8CALL90 (formerly ICALL) channel shall be expanded to include simulcast/voted system operation from additional sites, with coverage to be increased so as to provide mobile coverage across King County, using the same mobile configuration specified in the Coverage section.

4.27.2 Proposers shall include all new infrastructure to meet the requirement for countywide mobile radio operation. It is estimated that this simulcast system will require from six to eight sites in order to provide full mobile coverage of King County (including mountain-pass areas). Because this channel is shared throughout the central Puget Sound region with adjoining jurisdictions, there is the possibility that the defined King County 8CALL90 service area may be later expanded in the post contract design process to add facilities and service area. The proposed design shall allow for the graceful expansion into neighboring counties at a later date.

4.28  **7CALL Patching Capability**

4.28.1 Proposers shall include in their Proposal the delivery of analog audio from the 7CALL repeater at Squak Mountain. This audio shall be delivered to the each participating public safety answering point (PSAP) in King County, with monitor responsibilities to be determined through regional operational planning. No new 700 MHz “CALL” channel base stations are required by the Owner.
4.29 Back-To-Back Connection of 8TAC Repeaters and 7TAC Repeaters

4.29.1 Each of the four existing 8TAC repeaters shall be replaced with new base stations and be placed into a back-to-back configuration with a new base station operating on a designated 7TAC channel. The 700 MHz channel frequency shall be selected through regional planning at a later date. It is desired that when configured for back-to-back operation, that the repeater pair include all required equipment to provide for ‘de-vocoded’ audio and local PTT between each repeater without the need to take backhaul audio or repeater control functions to a remote location. The goal is to have fully stand-alone back to back repeaters that can function without connection to external console or P25 system infrastructure.

4.29.2 Proposers should recognize that the new 700 channels operate as P25 Phase I (FDMA) by FCC Rule, while the 8CALL channels must be operated as CTCSS-protected analog channels.

4.30 Performance Requirements

4.30.1 Demonstration of the proper operation of these systems shall be a required element of both factory and field testing. However, while the expected coverage performance of the conventional Interoperability system shall be shown in Proposer provided maps, the provided maps shall be used by Owner for informational purposes only. No Coverage Acceptance Testing shall be performed on these systems.

4.31 Specifications

4.31.1 Specifications for the 700/800 MHz conventional interoperability base station infrastructure shall be the same as the trunked radio system base station specifications.

4.32 VHF/UHF Systems General Requirements

4.32.1 All conventional base station/repeaters shall be configured for both analog narrowband (12.5 KHz) and APCO P25 Phase I (FDMA) CAI operation.

4.32.2 All proposed base station equipment shall be powered by -48 VDC common battery systems.

4.32.3 All required VHF and UHF base stations/repeaters required for the PSERN shall be used in a simulast configuration. As such, each station shall include provision for external frequency reference input from frequency and timing standards present at each radio site.

4.33 Conventional System Simulcast Transmission

4.33.1 The current VHF & UHF conventional analog system utilizes simulcast transmission technology for improved regional coverage. The Owner requires the proposed VHF&UHF conventional solution to also provide simulcast transmission technology. Thus the Proposer shall include simulcast modeling in their coverage design and shall include all required components to provide for simulcast operation. The Owner prefers simulcast technology that, if practical, utilizes the same common core components as used for the wide area 800 MHz P25 Phase II (TDMA) replacement radio system offering.

4.34 Remote Repeater Provisioning and Management

4.34.1 The proposed base stations shall be controlled and managed through the system management network, servers and workstations. The system shall provide the
ability to reconfigure individual repeaters through the network backhaul interface. Proposers shall indicate the extent to which repeater parameters can be configured remotely, and whether this programming is restricted to repeater parameters or also includes repeater operating system software. Desired capabilities for site management include the following as a minimum:

4.34.1.1 Deactivating individual channels and repeaters
4.34.1.2 Disabling repeater function for simulcast sites
4.34.1.3 Downloading and uploading repeater operating parameters
4.34.1.4 Downloading repeater firmware
4.34.1.5 Intelligent, automated adjacent site base station reconfiguration during simulcast operation upon the loss of any base station to eliminate unmanaged, unsynchronized overlap.

**4.35 Physical and Environmental Specification**

4.35.1 The VHF and UHF base and repeater stations shall be housed in standard 19" EIA racks, with six (6) stations (or more) per rack to conserve space, and all equipment shall meet the following minimum requirements:

4.35.1.1 The equipment shall operate over a temperature range of –30° to +60° C
4.35.1.2 The repeater shall be of an architecture that provides for field replaceable units (FRU)
4.35.1.3 The repeaters shall meet or exceed all applicable FCC requirements
4.35.1.4 All proposed stations shall fully comply with EIA requirements as they apply to both analog stations and P25 stations
4.35.1.5 The stations shall meet or exceed TIA-102 and TIA-603 “Class A” base station transmitter and receiver specifications
4.35.1.6 Repeaters shall provide automatic call sign identification that meets FCC requirements
4.35.1.7 Alarm outputs as required to deliver status information to the network monitoring system
4.36  VHF Transmitter Specification

4.36.1 The VHF base station/repeater transmitter performance shall meet or exceed the following specifications:

<table>
<thead>
<tr>
<th>VHF MHz BASE STATION TRANSMITTER PERFORMANCE SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range (MHz)</td>
</tr>
<tr>
<td>Channel Spacing (kHz)</td>
</tr>
<tr>
<td>RF Power Output (W)</td>
</tr>
<tr>
<td>Frequency Stability (-30 ~ +60°C)</td>
</tr>
<tr>
<td>Modulation Deviation (kHz)</td>
</tr>
<tr>
<td>Analog FM Hum and Noise (dB)</td>
</tr>
<tr>
<td>Audio Response (dB)</td>
</tr>
<tr>
<td>Spurious and Harmonic Emission Attenuation (dB)</td>
</tr>
<tr>
<td>Analog Audio Distortion</td>
</tr>
<tr>
<td>Modulation Fidelity (%)</td>
</tr>
<tr>
<td>Intermodulation Attenuation (dB)</td>
</tr>
<tr>
<td>P25 Adjacent Channel Power (dBc)</td>
</tr>
</tbody>
</table>

*Table 4.36 VHF Transmitter Specification*
4.37 VHF Receiver Specification

4.37.1 The VHF base station/repeater receiver performance shall meet or exceed the following specifications:

<table>
<thead>
<tr>
<th>VHF BASE STATION RECEIVER PERFORMANCE SPECIFICATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range (MHz)</td>
<td>136 - 174</td>
</tr>
<tr>
<td>Channel Spacing (kHz)</td>
<td>12.5, 15, 25, 30</td>
</tr>
<tr>
<td>Channel Selection Steps kHz</td>
<td>2.5, 5, 6.25</td>
</tr>
<tr>
<td>Analog Sensitivity for 12 dB SINAD (dBm)</td>
<td>-118 (12.5 kHz), -117 (25 kHz)</td>
</tr>
<tr>
<td>P25 Reference Sensitivity @ 5% bit error rate (dB)</td>
<td>-118 (C4FM)</td>
</tr>
<tr>
<td>P25 Adjacent Channel Rejection (dB)</td>
<td>&gt;60 (12.5 kHz)</td>
</tr>
<tr>
<td>Analog Adjacent Channel Rejection (dB)</td>
<td>&gt;75 (25 kHz/TIA603D)</td>
</tr>
<tr>
<td>Analog Intermodulation Rejection (dB)</td>
<td>&lt;75 (12.5 kHz)</td>
</tr>
<tr>
<td>Digital Intermodulation Rejection (dB)</td>
<td>&lt;80 (12.5 kHz)</td>
</tr>
<tr>
<td>Analog Spurious and Image Rejection (dB)</td>
<td>&lt;75 (12.5 kHz)</td>
</tr>
<tr>
<td>Digital Spurious and Image Rejection (dB)</td>
<td>&lt;90 (12.5 kHz)</td>
</tr>
<tr>
<td>Analog FM Hum and Noise (dB)</td>
<td>&lt;34 (12.5 kHz), &lt;40 (25 kHz)</td>
</tr>
<tr>
<td>Frequency Stability (-30 ~ +60°C)</td>
<td>±1.0 ppm</td>
</tr>
<tr>
<td>Analog Audio Response</td>
<td>+1, -3 dB from 6 dB per octave-de-emphasis, 300 – 3000 Hz referenced to 1 kHz</td>
</tr>
<tr>
<td>Analog Audio Distortion</td>
<td>&lt;3%</td>
</tr>
</tbody>
</table>

Table 4.37 VHF Base Station Receiver Specification
4.38 **UHF Transmitter Specification**

4.38.1 The UHF base station/repeater transmitter performance shall meet or exceed the following specifications:

<table>
<thead>
<tr>
<th>UHF BASE STATION TRANSMITTER PERFORMANCE SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range (MHz)</td>
</tr>
<tr>
<td>Channel Spacing</td>
</tr>
<tr>
<td>RF Power Output</td>
</tr>
<tr>
<td>Frequency Stability (-30 ~ +60°C)</td>
</tr>
<tr>
<td>Modulation Deviation (kHz)</td>
</tr>
<tr>
<td>Analog FM Hum and Noise (dB)</td>
</tr>
<tr>
<td>Audio Response (dB)</td>
</tr>
<tr>
<td>Spurious and Harmonic Emission Attenuation (dB)</td>
</tr>
<tr>
<td>Analog Audio Distortion</td>
</tr>
<tr>
<td>Modulation Fidelity (%)</td>
</tr>
<tr>
<td>Intermodulation Attenuation (dB)</td>
</tr>
<tr>
<td>P25 Adjacent Channel Power (dBc)</td>
</tr>
</tbody>
</table>

*Table 4.38 UHF Base Station Transmitter Specification*
4.39 **UHF Receiver Specification**

4.39.1 The UHF base station/repeater receiver performance shall meet or exceed the following specifications:

<table>
<thead>
<tr>
<th><strong>UHF BASE STATION RECEIVER PERFORMANCE SPECIFICATION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency Range (MHz)</strong></td>
</tr>
<tr>
<td><strong>Channel Spacing (kHz)</strong></td>
</tr>
<tr>
<td><strong>Channel Selection Steps (kHz)</strong></td>
</tr>
<tr>
<td><strong>Analog Sensitivity for 12 dB SINAD (dBm)</strong></td>
</tr>
<tr>
<td><strong>P25 Reference Sensitivity @ 5% bit error rate (dB)</strong></td>
</tr>
<tr>
<td><strong>P25 Adjacent Channel Rejection (selectivity)</strong></td>
</tr>
<tr>
<td><strong>Analog Adjacent Channel Rejection (selectivity)</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Analog Intermodulation Rejection (dB)</strong></td>
</tr>
<tr>
<td><strong>Digital Intermodulation Rejection (dB)</strong></td>
</tr>
<tr>
<td><strong>Analog Spurious and Image Rejection (dB)</strong></td>
</tr>
<tr>
<td><strong>Digital Spurious and Image Rejection (dB)</strong></td>
</tr>
<tr>
<td><strong>Analog FM Hum and Noise (dB)</strong></td>
</tr>
<tr>
<td><strong>Frequency Stability (-30 ~ +60°C)</strong></td>
</tr>
<tr>
<td><strong>Analog Audio Response</strong></td>
</tr>
<tr>
<td><strong>Analog Audio Distortion</strong></td>
</tr>
</tbody>
</table>

Table 4.39 UHF Base Station Receiver Specification

4.40 **Radio Site Antenna Systems**

4.40.1 The equipment identified in this specification shall be used at existing Owner facilities and shall replace presently installed VHF and UHF interoperability repeaters and base stations. The existing antenna systems, antenna cabling shall be replaced and filters shall be reused, unless Proposer identifies that such reuse is not appropriate. Any alternate antenna systems, antenna cabling and filters proposed shall be included in the fixed price portion of the Proposal.

4.41 **Dispatch Console Systems**

4.41.1 Dispatch operations across King County are currently divided among several geographically separated 911 call-taking and Public Safety Answering Points (PSAPs). Some larger cities have independent combined service dispatch

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services while some rural entities provide local dispatching services radio control station implementations.

4.42 Console Replacements

4.42.1 The Owner desires a best-in-class, IP connected, PC workstation-based dispatch solution offering the wide call feature set afforded by the P25 standard. The expectation is that COTS equipment be utilized for the PS workstation to allow simple sparing of common components and economical replacement over the life of the system.

4.42.2 Proposers shall propose an integrated console solution that implements full end-to-end IP technology, and provides maximum functional capabilities through the advanced feature set of the P25 CAI and trunked operation. The result of these advanced capabilities is improved safety of first responders, reduced dispatcher operational workload, positive notification and management of emergency precedence calls, seamless security of voice communications, and maintaining the integrity of subscriber fleets by selective deactivation and reactivation of radios that are unaccounted for, cloned or stolen.

4.42.3 The console, while utilizing an IP connection to the trunked radio system (RFSS), shall not require core connectivity for basic operation and shall be capable of fully autonomous operation (such as radio control station dispatching) if disconnected from the RFSS.

4.42.4 The Owner considers the dispatch consoles and its associated equipment to be part of the core radio system infrastructure. In addition to the base stations and other site equipment installed, dispatch consoles are an integral part of system infrastructure. Because of the importance of proper console integration into the larger radio network, Proposers shall propose dispatch console solutions that are engineered, built, installed and supported under a single radio system corporate umbrella. The Owner requires technical support to be a one call, one stop experience, within North America. The successful Proposer shall be completely responsible for the technical support, troubleshooting and repair for site infrastructure to include dispatch consoles.

4.43 Console Networking Requirements

4.43.1 The Proposer shall outline the required network architecture and performance requirements for reliable dispatch workstation operation. These shall include the following performance parameters:

4.43.1.1 Committed information rate for workstation connectivity during idle and active voice traffic

4.43.1.2 Latency/Delay

4.43.1.3 Jitter

4.43.1.4 Any special router requirements (unicast vs. multicast)

4.44 Dispatch Console Master Time Synchronization

4.44.1 Proposed console systems (includes all logging, recorders, alarms, console equipment, network controllers, etc.) that will be housed at all dispatch centers must be tied into a common timing reference. Proposer shall include in the Proposal new synchronized timing sources for each communication center. For each dispatch center, and ideally across the entire console network, clocks
displaying a date/time stamp on the dispatch consoles, and any logging features shall be synchronized to a common time source.

4.45 Console Furniture

4.45.1 The existing console furniture shall be reused for radio console installation. If deficiencies are noted during regional dispatch center site visits, Proposers shall identify the deficiencies to the Owner and include a resolution in their response. Any modification to the existing console operating position's functionality and/or furniture should give careful consideration of human ergonomics, and have concurrence from the Owner’s System Management and Radio Shop staff.

4.45.2 Table 4.45 below identifies requirements for consoles that will be directly integrated with the proposed PSERN.

<table>
<thead>
<tr>
<th>Console Systems</th>
<th>Qty</th>
<th>Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>City of Seattle</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Police</td>
<td>12</td>
<td>Fiber</td>
</tr>
<tr>
<td>Fire</td>
<td>15</td>
<td>Fiber</td>
</tr>
<tr>
<td>SPU</td>
<td>4</td>
<td>Fiber</td>
</tr>
<tr>
<td>UW PD</td>
<td>2</td>
<td>Fiber</td>
</tr>
<tr>
<td>Sound Transit (LCC)</td>
<td>3</td>
<td>Leased Ethernet</td>
</tr>
<tr>
<td>Sound Transit (OMF)</td>
<td>3</td>
<td>Leased Ethernet</td>
</tr>
<tr>
<td><strong>EPSCA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NORCOM</td>
<td>14</td>
<td>MW</td>
</tr>
<tr>
<td>Issaquah</td>
<td>2</td>
<td>Leased T1</td>
</tr>
<tr>
<td>Redmond</td>
<td>4</td>
<td>Fiber</td>
</tr>
<tr>
<td>Bothell</td>
<td>3</td>
<td>Leased T1</td>
</tr>
<tr>
<td><strong>Valley Co</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valley Com</td>
<td>21</td>
<td>MW</td>
</tr>
<tr>
<td><strong>King Co</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAJD</td>
<td>3</td>
<td>2xMW 1xLL 1xMW</td>
</tr>
<tr>
<td>DYS</td>
<td>2</td>
<td>LL</td>
</tr>
<tr>
<td>Enumclaw</td>
<td>2</td>
<td>N/A</td>
</tr>
<tr>
<td>Harborview Medical Center</td>
<td>2</td>
<td>2xMW 2xLL</td>
</tr>
<tr>
<td><strong>KC Office of Emergency</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td>1</td>
<td>MW</td>
</tr>
<tr>
<td><strong>King County Sheriff’s Office</strong></td>
<td>23</td>
<td>MW</td>
</tr>
<tr>
<td>TRIS Interoperability</td>
<td>1</td>
<td>CAT6</td>
</tr>
</tbody>
</table>

Table 4.45 Dispatch Console Requirements
4.46 ISSI Console Sub System Interface (CSSI)

4.46.1 The offered P25 Trunked RF Sub-System (RFSS) shall support the open-standard P25 Console Sub-System Interface (CSSI) as defined in the published Telecommunications Industry Association (TIA) document, 102.BACA-B. The offered RFSS shall include all necessary hardware and software components to enable the use of the CSSI without any additional or future cost to the Owner beyond the price offered in the vendor’s bid response. The RFSS Proposer shall submit proof of their compliance to the published CSSI Interoperability Test Procedure, TIA document 102.CACB-B.

4.46.2 Thus, Proposers shall present a comprehensive list of features supported by the proposed dispatch console solution. Proposers shall disclose any enhanced dispatch capabilities or features that utilize proprietary technology that would preclude P25-compliant radio subscriber units of mixed manufacture from exploiting the capability or function. Operational benefits or advanced capabilities made possible by exploiting such proprietary technology shall be clearly stated and presented by the Proposer for comparison and consideration. Likewise, any limitations associated with that option on other equipment shall be disclosed.

4.46.3 In addition, as TIA standards relevant to the CSSI are updated or newly published, any additional open-standard P25 console feature enabled by the subsequent published standards that have been incorporated into the future firmware or software of the offered RFSS product, shall be offered to the Owner at no extra charge other than the normal fee for ongoing software maintenance. This requirement specifically includes the future incorporation of Dynamic Regrouping (SOR 2.1.2.15/16) and Discrete Listening (SOR 3.3.5.11) features via the CSSI. All future installed software releases shall maintain compliance and backwards compatibility with the TIA standards referenced above.

4.47 Console Configurations

4.47.1 For purposes of this RFP, IP technology consoles shall be proposed that are PC-based, with LCD touch screens and local interface equipment as required to support interface with dispatcher audio equipment, to include both 9-1-1 and administrative telephone lines. This shall include the ability to support dual audio jacks, as well as dual foot pedals for user training purposes. Dispatch console equipment shall be powered from 120 VAC at 60 Hz. Proposers shall specify required electrical current.

4.47.2 The console computer operating system (OS) shall be certified by the Proposer to be stable and capable of being supported on both Proposer-supplied console workstation PC's, as well as PC's that may be supplied by the Owner. The use of commercial, off-the-shelf (COTS) PC’s is preferred. The offered dispatch console solution shall support future technology progressions of OS revisions, and shall not be made unstable or non-operational due to the future OS releases.

4.47.3 Each console shall support a system of managing talk group and channel resources that allows creation of multiple folders or their equivalent, with each folder representing a pre-established operational configuration. Dispatch personnel shall be able to select a folder that represents their operational configuration. Selecting an alternate folder shall have the console position reconfigure itself without further operator intervention. Within each folder, the system shall provide a display of pre-configured channel and talk group representations or "modules". Proposers shall state how many channel or talk...
group modules may be configured for each folder. In addition, Proposers shall explain how many expanded (open) talk group modules can be displayed on one screen at any given time using graphic illustrations.

4.47.4 Each module shall provide the following minimum capabilities:

4.47.4.1 Individual volume control, with settable minimum volume levels to prevent missing calls in the unselected audio

4.47.4.2 Individual muting control, with unselected resources being capable of muting

4.47.4.3 Busy indication when a module is in active use, with a parallel display of status at the other consoles in the system

4.47.4.4 Calling radio ID and alias display

4.47.4.5 Calling unit call history

4.47.4.6 Encryption ON/OFF selection

4.47.5 The console shall permit the operator to monitor call activity using up to four separate speakers, one providing select audio and the others with unselect audio. The console shall permit the Dispatcher to route any module to the speakers. The successful Proposer shall be responsible for working with PSERN Dispatch staff to design the system screens, modules and configurations to produce an Owner-approved configuration scheme that Proposer shall be responsible for enabling in all dispatcher consoles.

4.48 Operator Position Flat Panel Display Space Limitations

4.48.1 Proposers are advised that current console operator position desktop space is limited and should take this into account for both proposed console solutions and also during the transitional phase of the project when the two systems are required to be in temporary parallel operation. Present operator position utilizes a minimum 20” LED backlit LCD touch screen monitor.

4.49 Dispatch Console Operational Capabilities

4.49.1 Dispatch consoles shall be capable of being programmed to support communication with one or more user entities, which could include trunked talk groups, conventional channel resources, or other console positions in intercom mode (both co-located or at alternate remote locations). Console equipment shall also provide the capability to manage individual calls, display field radio user status messages and generate SMS-style text pages to field users.

4.49.2 Specific dispatch console capabilities that are required for system operation are shown below:

4.50 Console Priority

4.50.1 The dispatch console shall have multiple selectable priority levels and must be capable of being assigned highest priority on the radio system.

4.51 Parallel Operation

4.51.1 The dispatch console shall be capable of listening to BOTH radio and additional operators in parallel. Ensures no audio will be unheard when the console takeover feature is enabled.
4.52 Radio Unit PTT ID
4.52.1 The dispatch console operator position shall display the radio subscriber unit ID on its associated talk group during trunked operation and on a channel during conventional operation. The ID shall be displayed in alphanumeric format based on the assignment of names or aliases.

4.53 Encryption
4.53.1 The dispatch console system shall support end-to-end digital voice encryption including AES-256 and DES-OFB. This encryption shall be contiguous from the dispatch console to the user radio, with no clear audio available at any intervening location. Proposer shall detail their process for clear recording of encrypted traffic in the voice recorder.

4.54 Radio Disable
4.54.1 It is highly desired for the Dispatch Supervisor to have the ability to selectively disable or enable an individual radio based upon its subscriber ID number. This feature should be enabled based on secure logon rather than by specific console position.

4.55 Analog Paging and Alert Tone Generation
4.55.1 The dispatch console system shall utilize the DVSI AMBE +2 VOCODER to reliably pass discrete analog tones and DTMF tones for the purpose of post-transmission alert tone sequences, channel busy markers and paging operations for fire service communications. The Owner understands that DVSI AMBE +2 VOCODER technology currently supports only a predefined set of analog tone frequencies for encoding and decoding purposes.

4.56 Dispatcher Call Override
4.56.1 The dispatcher shall have the ability to interrupt a call in progress by members of the same talk group, overriding the call so that all members present in the talk group hear only the dispatcher.

4.57 Emergency Call Management
4.57.1 When a radio subscriber unit depresses a dedicated emergency button in a standard talk group, the dispatch console position shall, upon receiving the call, alert the operator with both an audible and visual alarm. The operator shall be required to manually acknowledge the alarm in order to clear the audible alert and visual indication. The dispatch console should allow options for defining the alarm acknowledgement response sequence to clear a received emergency alarm. The call history shall display the push-to-talk (PTT) ID and alias of the unit declaring the emergency, along with date and time of the emergency call.

4.58 Patches
4.58.1 The console shall support patches, which involves temporarily combining two or more talk groups (or channels in a conventional environment). A patch merges the entities into a common group, such that each member hears every other member. Each console shall be able to support up to ten (10) patches (talk groups and/or conventional channels) each. All entities patched together shall be able to communicate with one another. The console shall support pre-configured patches or tactical, on-the-fly patch setups. Proposers shall note any limitation on the
number of talk groups or conventional channels that may be merged into a single patched resource.

4.59 Simultaneous-Selection

4.59.1 Consoles shall support simulselect, which involves temporarily summing two or more modules at the console, rather than at the system level. Simulselect merges the entities for the benefit of the dispatcher, but does not create a common group. Only the dispatcher can hear all simulselect members. Each console shall be able to support up to ten (10) simulselects. The dispatcher shall be able to communicate with all entities contained in a single simulselect. The console shall support pre-configured simulselects. Proposers shall note any limitation on the number of talk groups or conventional channels that may be merged into a single simulselect resource, and the number of simulselects available per console in their proposed system.

4.60 Call or Activity History Log

4.60.1 Received calls shall be recorded with a date and timestamp for immediate or later review via a user-accessible and re-sizable window. The talk group and individual identification of received calls shall be displayed with the alphanumeric alias for ease of identification.

4.61 SMS or Text Message History Log

4.61.1 Received or transmitted short data (text) messages shall be recorded with a date and timestamp for immediate or later review via a user-accessible and re-sizable window. The identification of a received message shall be displayed with the alphanumeric alias presentation for ease of identification. Proposer shall disclose typical archival and retention approaches for these messages.

4.62 Call-Check / Instant Recall Recording (IRR)

4.62.1 Typically used for last (missed) call and quick rewind or repeat of needed information, this capability stores several minutes to several hours of time-stamped audio clips for "instant" playback. For this requirement, a minimum of sixty (60) minutes of Call Check recorded audio per position shall be available for dispatcher playback. No additional desktop or other hardware shall be required to support the Call-Check or IRR function.

4.63 Auxiliary Input/Output (AUX I/O)

4.63.1 Consoles shall also provide for auxiliary input/output (I/O) controls for controlling equipment either locally or at remote locations such as colored status lights to indicate transmit, receive, and emergency call status. This shall be provided at each operator position through the use of a physical interface that provides Form-C relays or open collector connections.

4.63.2 Centralized and local AUX I/O sense and control capability is desired. Centralized AUX I/O shall be considered a shared resource accessible from any or all console operator positions. Local AUX I/O shall be considered a local resource limited to each operator position.

4.63.3 Local AUX I/O capability per operator position for simplified wiring to lighting control is highly desirable.
4.63.4 Console position required AUX I/O interface quantities are outlined in Table 4.63 below:

<table>
<thead>
<tr>
<th>Location</th>
<th>Centralized Qty. I/O Contact Pairs</th>
<th>Local Qty. I/O Contact Pairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seattle PD</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Seattle FD</td>
<td>128</td>
<td>16</td>
</tr>
<tr>
<td>Valley Com</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Issaquah</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Kirkland</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Redmond</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Bothell</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>NORCOM</td>
<td>128</td>
<td>16</td>
</tr>
<tr>
<td>King Co.</td>
<td>32</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 4.63 Auxiliary I/O

4.64 Central Console System Management

4.64.1 The radio system dispatch equipment and database shall be capable of being configured and managed from anywhere within the system management network. Console resource management should be integrated with the overall system network management approach.

4.65 Partitioning of Access to Console Configuration Parameters

4.65.1 The radio system dispatch architecture should be capable of supporting agency and dispatch center partitioning of features and functionality to ensure that the level of customization and modification to any dispatch console programmable configurations can only be accomplished by a user with a corresponding level of access.

4.65.2 This shall be implemented by various levels of logon access, whereby users are assigned priorities. Levels of dispatch operating position configuration and editing are based upon assigned user priority validated during the logon process. Partitioned access shall extend to both console configurations and to audio resource management, as well as provisioning and configuration by technical support staff.

4.66 Link Failure

4.66.1 The console shall visually notify the dispatcher of any link failure between the console position and the system central control equipment.

4.67 Radio System Failure Notification

4.67.1 Proposers who have the ability to deliver an indication of radio system failures (such as loss of wide area operation) to console operators shall note their ability to deliver such notifications.
4.68 Conventional Operation

4.68.1 The console shall be able to control conventional control stations and repeaters and provide the following functions:

4.68.1.1 Control base station transmit/receive operation using tone remote control and 4 wire E&M control. Any additional proprietary control types should be noted in the proposal

4.68.1.2 Select the station’s transmit/receive frequency pair using tone remote control

4.68.1.3 Enable duplex base stations and voting comparators to repeat radio originated audio using tone remote control

4.68.1.4 Enable scan of selected channels in multi-channel control stations using tone remote control

4.68.1.5 Enable toggling between main base stations and standby base stations using tone remote control

4.68.2 Proposers shall state how many simultaneous conventional talk paths and receive audio sources the proposed consoles and supporting electronics allow.

4.68.3 Table 4.68 below shows the total number of conventional channel resources required at each communications center.

<table>
<thead>
<tr>
<th>City of Seattle</th>
<th>Police</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fire</td>
<td>28</td>
</tr>
<tr>
<td>University of Washington Police</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Sound Transit (LCC))</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Sound Transit (OMF)</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EPSCA</th>
<th>NORCOM</th>
<th>33</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issaquah</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Redmond</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Bothell</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Valley Com</td>
<td>Valley Com</td>
<td>25</td>
</tr>
<tr>
<td>King County</td>
<td>DAD</td>
<td>0</td>
</tr>
<tr>
<td>Enumclaw</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Harborview Medical Center</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Juvenile Detention</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>KC Office of Emergency Management</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>King County Sheriff’s Office</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>TRIS</td>
<td>Tri-County Regional Interoperability System</td>
<td>28</td>
</tr>
</tbody>
</table>

Table 4.68 Conventional Channel Resources

RFP#1084-13-RLJ PART C: Scope of Work and Specifications
4.69  **Telephone Radio Headset Interface (TRHI)**

4.69.1 Dispatch operator positions shall have a telephone radio headset interface (TRHI) that provides telephone audio (separate 911 and administrative circuits) as well as radio audio to provide a combined (mixed) audio source for operators.

---

4.70  **Footswitch Required**

4.70.1 The proposed console shall provide for console front panel and dual footswitch control over console PTT.

---

4.71  **Optional Console or Desktop Microphone**

4.71.1 The proposed console shall provide for use of a console-attached gooseneck microphone or desktop microphone. The pricing for an optional console gooseneck microphone or desktop microphone shall be priced as an option in the Proposal.

---

4.72  **Console Position Audio Management and Jack Box Requirements**

4.72.1 Dispatchers wear monaural headsets with a two-prong amplifier and interface to the phone and radio at each console through a dual jack box that allows a second operator or supervisor to plug-in to monitor or assist with calls (as well as for training purposes).

4.72.2 The Proposer's proposed console audio interface solution shall incorporate one (1) dual plug receptacles installed at the immediate left, and another dual plug receptacles installed at the immediate right of each operator position. This shall allow the local dispatch operator as well as a second user (e.g. supervisor, trainee, etc.) to plug in and permit both users to access radio and telephone circuit receive audio, and PTT capability. The audio interface shall support industry standard 4-wire and 6-wire headset w/inline PTT operation. The Proposer shall provide a list of wired and wireless headset manufacturers and models that are approved for use on the offered solution.

---

4.73  **TIA102 Conventional Fixed Station Interface (CFSI) Support**

4.73.1 The Owner desires maximum dispatch capabilities for applications that may implement direct or wire-line connections to a conventional P25 digital base station for non-trunked applications. The features and capabilities offered in dispatch consoles supporting the Digital Fixed Station Interface (DFSI) is highly desirable, especially the ability to maintain a pure IP connection to the base station and passing and processing of P25 CAI call information to the console.

4.73.2 Proposers are requested to disclose in their proposed dispatch product's current compliance and supported functionality of the Fixed Station Interface as outlined by TIA-102BAHA.

---

4.74  **Analog Console to Console Interfaces Required**

4.74.1 Analog interfaces between consoles are required as a part of the PSERN. This capability is so that other conventional and non-P25 trunked radio systems may be activated between PSERN consoles and consoles operated by non-PSERN agencies. This allows PSERN talkgroups or conventional radio system resources to be patched to consoles operated by non-PSERN jurisdictions.
4.74.2 These console initiated patches are a part of the Tri-County Regional Interoperability System (TRIS). The quantity of console to console interfaces required is fourteen (14) as shown in Table 4.74.

<table>
<thead>
<tr>
<th>Location</th>
<th>Console Interfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connections to Snohomish Co. (SERS)</td>
<td>2</td>
</tr>
<tr>
<td>Connections to Tacoma/Puyallup</td>
<td>2</td>
</tr>
<tr>
<td>Connections to Port of Seattle</td>
<td>2</td>
</tr>
<tr>
<td>Integrated Wireless Network (IWN)</td>
<td>2</td>
</tr>
<tr>
<td>Kitsap County (never established)</td>
<td>2</td>
</tr>
<tr>
<td>Washington State Patrol (WSP)</td>
<td>1</td>
</tr>
<tr>
<td>Comm Center Intercom (party line)</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14</strong></td>
</tr>
</tbody>
</table>

Table 4.74 Tri-County Regional Interoperability System

4.75 Analog Base Station Interfaces Required

4.75.1 4 Wire analog interfaces using E&M signaling or tone remote signaling are required as a part of the PSERN. This capability is so that other conventional and non-P25 trunked radio systems may be activated from PSERN consoles or users operating on patched talkgroups.

4.75.2 These include console initiated patches between analog radio systems, as well as the ability to control locally connected base stations and control stations that access other radio systems outside of the PSERN. The quantity of interfaces required is as shown in Table 4.75 (note that these quantities do not include the interfaces required as a part of the VHF, UHF, 700 MHz and 800 MHz conventional radio system requirements described in Section 4 of this RFP).

4.75.3 These 4 wire E&M and tone remote base station interface capabilities shall be accessible from within the radio system IP network and available at each console position as required by Owner operational requirements.

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of Analog Interface Connections (discrete base station interfaces)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each communications center (in addition to the number of radio interfaces required to provide connection to console positions for back-up purposes)</td>
<td>51 (City of Seattle)</td>
</tr>
<tr>
<td></td>
<td>17 (Valley Comm)</td>
</tr>
<tr>
<td></td>
<td>34 (King County)</td>
</tr>
<tr>
<td></td>
<td>35 (EPSCA)</td>
</tr>
</tbody>
</table>
Table 4.75 Analog Base Station Interface

4.76 Back-up Radio Control Station Requirement Overview

4.76.1 The Owner requires dispatch operations to continue should loss of connectivity (digital or directly wired) occur between the dispatch console and the central trunking system infrastructure, switch, or console gateway interface. This requirement is currently met through the use of multiple trunked mobile radio control stations installed locally in the dispatch facility.

4.76.2 It is significant to note that radio control stations perform multiple roles within the current system, based upon individual PSAP requirements and applications. These configurations are as follows:

4.76.2.1 Control Station Only – trunked mobile control stations are used only for backup dispatch capability in the event of loss of console network connectivity to the central trunking switch. Multiple trunked mobile control stations are fed from a control station combiner and used for control station functions only.

4.76.2.2 Off-Air Audio Feed for Logging Recorder—each radio is programmed with a talk group used for 24/7 off-air monitoring of call traffic. Audio from the control stations are fed to an analog logging recorder for archiving of radio traffic. In this configuration, multiple trunked mobile control stations are fed from a control station combiner and used for reception only.

4.76.2.3 Dual Role—the radio control station’s primary role is for off-air logging as described above, but also is wired for local control from a dispatch operator position. In the event of loss of wire-line control between console and switch, the radio can then also be used for backup dispatching.

4.76.3 The Proposer shall provide any interfaces required to provide 600-ohm balanced audio at required levels from the mobile radios for interfacing with logging recorder equipment inputs.

4.77 Future Backup Control Station Capability

4.77.1 Proposers shall take into account the flexibility and dynamic role of control stations in the PSERN when formulating their offered product platform as a solution. Backup dispatching is a required core capability and responses shall include a proposed solution providing equivalent or better capability to that presently implemented. The Owner is aware that current P25 mobile radio subscriber units implement both TIA-standard basic as well as advanced remote control schemes made possible by IP data control and specialized software command sets that allow enhanced capabilities such as emulation of all radio front panel controls, talk group and PTT ID display, and more. Proposers shall outline the level of capabilities afforded in their control station solution and weigh the benefits of each as it applied the PSERN model.

4.77.2 Control stations and the proposed desktop remote configuration should, at a minimum, allow:

4.77.2.1 PTT via handset, desk microphone or foot switch

4.77.2.2 Selection of multiple predefined Zones and Channels, where channels can be either trunked talk groups or conventional channels
4.77.2.3 LCD display of the selected Zone and Talk Group

4.77.3 Highly desirable additional features include:

4.77.3.1 Decoding and display and TG ID and PTT ID

4.77.3.2 4-wire analog or full IP circuit connectivity options for linking

4.77.3.3 Use of headset (preferred), handset and desk microphone

4.77.4 Based upon the information above, the Proposer shall recommend a design and disclose costs to implement a back-up radio control station dispatch system. Proposer shall describe the mobile radio interface methods; capabilities afforded by each interface, as well as suitability for use with the proposed primary dispatch console, or recommended replacement desktop telephone-style handsets.

4.78 Control Station Replacement Considerations

4.78.1 Control station dispatching shall utilize 700/800 MHz mobile radio-based control stations, as needed and depending upon service.

4.78.2 The successful Proposer shall evaluate the existing control station system and provide a one-for-one functionally-equivalent replacement or better. Specific items for consideration of this replacement include, but are not limited to:

4.78.2.1 Replacement of existing mobile transceivers with 700/800 MHz P25 equivalent units

4.78.2.2 Provision of control station transmit/receive combiners

4.78.2.3 New omnidirectional antennas for 700/800 MHz

4.78.2.4 Potential replacement of existing coaxial cable runs

4.78.2.5 Replacement of 12 VDC power supplies with appropriate current capacity for proposed replacement P25 mobile transceivers

4.78.3 The control station shall consist of a mobile radio transceiver installed within a custom enclosure that provides a 120VAC to 12VDC power supply of appropriate power rating, along with internal fan cooling for temperature management.

4.78.4 The offered solution shall provide the following minimum supported features:

4.78.4.1 AC & DC power Inputs

4.78.4.2 Front Panel Microphone

4.78.4.3 Keypad Operation

4.78.4.4 Front Panel Speaker

4.78.4.5 Clock and VU Meter

4.78.4.6 Wireline Interface with support for 4Wire E&M and Function Tone Control

4.78.4.7 Digital Serial Data Interface Control

4.78.4.8 Headset Connection (optional)

4.78.4.9 External PC programming port

4.78.4.10 External Encryption Key Fill port

4.78.4.11 General Purpose AUX I/O ports
Proposals should include the cost of each of the three configurations shown for each center in Table 4.78, along with control station combining required to combine all stations into the absolute minimum number of antennas, while still providing adequate receive/transmit signal levels to properly access remote radio sites.

<table>
<thead>
<tr>
<th>Location</th>
<th>Service</th>
<th>Qty. Control Stations</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seattle</td>
<td>Police</td>
<td>27</td>
<td>Logging and back-up use combined</td>
</tr>
<tr>
<td></td>
<td>Fire</td>
<td>27</td>
<td>Logging and back-up use combined</td>
</tr>
<tr>
<td></td>
<td>UW PD</td>
<td>6</td>
<td>6 ea. 4-W w/ logging, 0 ea. RX only logging, 0 ea. Standalone, no logging</td>
</tr>
<tr>
<td>EPSCA</td>
<td>NORCOM</td>
<td>14</td>
<td>back-up only</td>
</tr>
<tr>
<td></td>
<td>Issaquah</td>
<td>2</td>
<td>back-up only</td>
</tr>
<tr>
<td></td>
<td>Redmond</td>
<td>4</td>
<td>back-up use only</td>
</tr>
<tr>
<td></td>
<td>Bothell</td>
<td>3</td>
<td>Logging and back-up use combined</td>
</tr>
<tr>
<td>Valley Com</td>
<td>Valley Com</td>
<td>81</td>
<td>17 ea. 4-W with logging, 24 ea. RX only logging, 40 ea. Standalone, no logging</td>
</tr>
<tr>
<td>King Co.</td>
<td>DAD</td>
<td>3</td>
<td>0 ea. 4-W w/ logging, 0 ea. RX only logging, 3 ea. Standalone, no logging</td>
</tr>
<tr>
<td></td>
<td>Enumclaw</td>
<td>6</td>
<td>5 ea. 4-W w/ logging, 0 ea. RX only logging, 1 ea. Standalone, no logging</td>
</tr>
<tr>
<td></td>
<td>Harborview MC</td>
<td>1</td>
<td>0 ea. 4-W w/ logging, 0 ea. RX only logging, 1 ea. Standalone, no logging</td>
</tr>
<tr>
<td></td>
<td>Juvenile Det.</td>
<td>1</td>
<td>0 ea. 4-W w/ logging, 0 ea. RX only logging, 1 ea. Standalone, no logging</td>
</tr>
<tr>
<td></td>
<td>KC OEM</td>
<td>1</td>
<td>0 ea. 4-W w/ logging, 0 ea. RX only logging, 1 ea. Standalone, no logging</td>
</tr>
<tr>
<td></td>
<td>KCSO</td>
<td>68</td>
<td>19 ea. 4-W w/ logging, 40 ea. RX only logging, 9 ea. 4-W w/ logging</td>
</tr>
</tbody>
</table>

Table 4.78 Control Station Replacement
### 4.79 Recording of Radio and Telephone Traffic

#### 4.79.1 Present radio system traffic is logged and recorded by a variety of dispersed digital voice recorder system located at the multiple PSAPs in King County. The present recording strategy used at the PSAPs within King County depends upon individual recorders located at each dispatch center. No centralized recording is currently being used. Each center records both radio and telephone traffic on their recorders. The present configurations for each dispatch center are shown in Table 4.79 below.

<table>
<thead>
<tr>
<th>Location</th>
<th>Service</th>
<th>Present Logging Recorder Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seattle</td>
<td>Police</td>
<td>Single recorder for both radio and telephone</td>
</tr>
<tr>
<td></td>
<td>Fire</td>
<td>Single recorder for both radio and telephone</td>
</tr>
<tr>
<td></td>
<td>UW PD</td>
<td>Single recorder for both radio and telephone</td>
</tr>
<tr>
<td></td>
<td>Sound Transit</td>
<td>Single recorder for both radio and telephone</td>
</tr>
<tr>
<td>EPSCA</td>
<td>NORCOM</td>
<td>Single recorder for both radio and telephone</td>
</tr>
<tr>
<td></td>
<td>Issaquah</td>
<td>Single recorder for both radio and telephone</td>
</tr>
<tr>
<td></td>
<td>Redmond</td>
<td>Single recorder for both radio and telephone</td>
</tr>
<tr>
<td></td>
<td>Bothell</td>
<td>Single recorder for both radio and telephone</td>
</tr>
<tr>
<td>Valley Com</td>
<td>Valley Com</td>
<td>Single recorder for both radio and telephone</td>
</tr>
<tr>
<td>King Co.</td>
<td>DAJD</td>
<td>Recorded at KCSO</td>
</tr>
<tr>
<td></td>
<td>Enumclaw</td>
<td>Single recorder for both radio and telephone</td>
</tr>
<tr>
<td></td>
<td>Harborview MC</td>
<td>No recording</td>
</tr>
<tr>
<td></td>
<td>Juvenile Detention</td>
<td>Recorded at KCSO</td>
</tr>
<tr>
<td></td>
<td>KC OEM</td>
<td>Recorded at KCSO</td>
</tr>
<tr>
<td></td>
<td>KCSO</td>
<td>Single recorder for both radio and telephone</td>
</tr>
</tbody>
</table>

#### Table 4.79 Recording of Radio and Telephone Traffic

#### 4.79.2 Recording of all radio system talk groups occurs at each dispatch center. At the time of this RFP, these recording systems shall remain in use. Proposers shall include all costs associated with interface to the existing recording systems as a part of their Proposal.
4.79.3 Proposers shall be responsible for interfacing the installed replacement radio system and the existing voice recording system. The voice recording system and its operation shall be commissioned with the radio system. Proposer is responsible for ensuring the Administrative and 911 call recording is maintained through the transition to the new radio recording process.

4.79.4 While the present recording system uses radio system audio for its source, the Owner recognizes radio traffic recording and playback can be accomplished by several technologies, such as, but not limited to:

4.79.4.1 Direct analog connection to suitable recorders using various technologies, including proprietary technologies

4.79.4.2 Dedicated mobile radio control stations on fixed talk groups/channels delivering off-air audio to local recorders

4.79.5 Off-air (radio control station audio) is required at the communication centers as described in Table 4.78.

4.79.6 This shall be proposed as a priced option.

4.80 Centralized IP Recorder Requirement

4.80.1 The Owner requires the recording of talk groups and transmitted console audio to be through a direct IP connection between the radio system and the centralized recording system at a location or locations to be determined in the radio system design process

4.80.2 This shall be proposed as a required capability.

4.81 Recording System Functionality

4.81.1 The proposed centralized recording system shall support the following minimum functions:

4.81.1.1 Medium Duration Logging to allow several hours to several days of Time/date-stamped recorded audio for playback. For this requirement, a minimum of two (2) days of Medium Duration Logging audio per position shall be recordable for dispatcher and supervisor playback.

4.81.1.2 Archival Logging Recorders shall utilize a storage technology that allows three (3) years of long-term permanent and guarded storage of multiple tracks of audio streams with time/date stamps and audible time markers. All recording systems proposed shall provide time, date and audio source stamping of the recorded audio, regardless of origin (i.e., direct connection to switch, interface gateway or sourced from radio control stations).

4.81.1.3 Console-Independent Audio Recording of all radio system talk groups shall occur centrally at the central recorder location. Audio shall be routed to the archiving recorder independent of dispatch console audio selections. Console local ("select" and "un-select") audio recording is for instant-recall use only.
4.82 IP Logging Recorder Specifications

4.82.1 The provisioning requirements for a proposed logging recorder system are as follows:

4.82.1.1 Recording of P25 radio system traffic over an IP based system. This shall be provisioned for four hundred (400) talkgroups

4.82.1.2 Twenty (20) recording ports for regional mutual aid channels delivered over the IP radio network

4.82.1.3 Twenty (20) analog recording ports for regional mutual aid channels

4.83 IP Logging Recorder General Requirements

4.83.1 New equipment

4.83.2 Capability to record both analog and digital audio inputs

4.83.3 Recording capability for radio system

4.83.4 APCO Project 25 (P25) compliant

4.83.5 Proposer certified solution

4.83.6 IP recording for console position radio audio

4.84 IP Logging Recorder Post-Processing Features

4.84.1 Capability to build an audio file for a specific incident with remote access

4.84.2 Audio redaction with notations

4.84.3 Merge several pieces of data from different channels into a single audio file

4.84.4 Adjust rate of audio playback (slow down or speed up)

4.84.5 Ability to display time and date stamp per the original event

4.85 IP Logging Recorder Ease of Use Features

4.85.1 Ease of use is a major factor in evaluating vendor’s solutions. Vendors should propose solutions for managing the IP logging recorder system using a single management tool with a simple graphical user interface (GUI). Users should be able to configure, optimize, monitor and track usage within a single GUI. The ease of use of the logging recorder hardware and the data storage and retrieval software are equally important. Vendors should provide a description of ease of use features for the hardware as well as system management software tools, including:

4.85.1.1 Remote playback – dial in

4.85.1.2 Playback and record from supervisors workstation

4.85.1.3 Playback and record from transcriptionist’s workstation

4.85.1.4 Remote system monitoring

4.85.1.5 Unit search with alias
4.86 IP Logging Recorder Security Features

4.86.1 As with any public safety communications system, security will be of the utmost importance for Owner. Proposers should include information regarding security features of the proposed solution, including:

4.86.1.1 Capability to store data in encrypted format
4.86.1.2 Security partitioning so that the system shares live or stored audio and data only with designated personnel such as prosecutors, supervisors, etc.
4.86.1.3 Capability to provide authentication of recorded material with a digital signature
4.86.1.4 Capability to provide audit trail for all information stored and retrieved from the system

4.87 IP Logging Recorder Monitoring and Reporting Features

4.87.1 Monitoring capability from supervisor positions
4.87.2 Talk group use analysis
4.87.3 Alarm to radio system NMS if system is in major or minor alarm status

4.88 IP Logging Recorder Data Storage Features

4.88.1 Have extended retention periods or special record tagging capabilities for preservation or critical incident recordings
4.88.2 Availability of additional offsite storage

4.89 IP Logging Recorder Redundancy and Reliability Features

4.89.1 Reliability is essential for public safety communications where call takers, dispatchers and first responders are continuously relying upon voice recording capabilities 24 hours a day, 365 days a year. Because use of a centralized recording strategy will potentially support the critical recording needs of so many agencies, the central recording solution proposed must be configured as a high availability system. At a minimum, the proposed system shall include redundant configuration and be designed to be used with the power systems supplied at the central radio system switch location or locations. Proposers must detail how their solution shall meet the required reliability specification.

4.89.1.1 Redundant systems
4.89.1.2 99.99% uptime
4.89.1.3 The voice logging recorder must support an internal hot-swappable RAID disc array
4.89.1.4 All primary recorders must support dual hot swap power supplies
4.89.1.5 Network storage

4.89.2 IP Logging Recorder Licenses

4.89.2.1 Any feature or component mentioned in the IP logging recorder solution should have appropriate software licenses included in the Proposal cost. Features and services that are not part of the Proposal, but the Proposer believes are necessary or may be beneficial may be listed in
the pricing response as optional and shall be considered when evaluating the vendors’ solutions.

4.89.3 IP Logging recorder Scalability

4.89.3.1 IP recorder solutions should provide scalability as much as possible to provide easy capacity upgrades to meet increasing traffic demands, and provide maximum flexibility for Owner to implement Next Generation (NG) 911 technologies. The ability to expand the system beyond the minimum capacities present here shall be clearly stated by Proposers.

4.90 Transportable or Tactical Use PC-based IP Consoles

4.90.1 The Owner has identified dispatching requirements and roles where a full-scale console configuration such as those utilized in the primary dispatch center exceeds user or mission requirements. The flexibility offered by IP connectivity and specialized application software on a common PC to create a mid-tier dispatching solution is both attractive and functional to the Owner’s requirements.

4.90.2 Proposer shall identify products that meet additional dispatch system control requirements. These are for distributed IP-connected control of the radio system at remote locations and for the short distance remote control of small base or control stations. The assumed platform to accomplish this would be a common (or Proposer-recommended and tested make and model) laptop or transportable computer running current or recent Microsoft Operating Systems (Windows 7, Windows 8). These may be suitable for remote dispatch operations in a mobile command center, on-site, back-up, training, or table-top exercise scenarios.

4.90.3 Requirements exist for deployment of IP network connected Transportable or Tactical-Use PC-Based IP Consoles, which provide the following capabilities:

4.90.3.1 Support remote connection to the system central switch using IP

4.90.3.2 VPN or equivalent security over the remote connection

4.90.3.3 Support for a minimum of eight (8) talk groups

4.90.3.4 Support for all key console requirements

4.90.3.5 Option for remote encrypt/decrypt

4.90.3.6 Application shall be capable of being run on a laptop or other transportable PC

4.90.3.7 Application shall be capable of being run on a PC (where internal encryption hardware may be required).

4.90.3.8 PC hardware compatibility supported by USB dongle or external PCI bus chassis.

4.90.3.9 Allows interfacing various audio accessories (i.e. Proposer provided wired or Bluetooth™ headsets)

4.90.4 The IP console solution and associated gateways are expected to operate within and via PSERN’s core IP infrastructure and to tie to the Wide Area Trunked System Controller. The proposed solution should be compatible with common enterprise-grade WAN/LAN routers, switches, firewalls and access point equipment, and shall not require or rely upon Proposer-specific or modified COTS equipment for operation.
4.90.5 The Proposer shall disclose minimum IP network transport requirements for reliable operation to allow the Owner to qualify the suitability of the proposed IP console prior to consideration. As a minimum the following required network performance parameters shall be provided in the Response:

4.90.5.1 Workstation and radio gateway IP Payload (Kbps Ethernet for idle and active conditions)
4.90.5.2 Packet Loss (%)
4.90.5.3 Data capacity/Bandwidth requirements
4.90.5.4 Minimum required committed information rate
4.90.5.5 Latency and Jitter limitations
4.90.5.6 Simulcast UDP requirements

4.91 Computer Aided Dispatch (CAD) Integration

4.91.1 The PSAPs operating within King County operate their own independent CAD systems. While there are on-going discussions related to some degree of additional consolidation of these PSAPs into a smaller number of dispatch centers, it is desired that the replacement radio system deliver data and receive data from each center in the same general manner as the present regional approach. This approach takes radio system data provided by the current Motorola CADI™ interface and delivers that information to a neutral message switch. The message switch, in turn, delivers data to each of the connected CAD systems. Similarly, the CAD systems may send various control messages through the message switch to the present Motorola system. The message switch serves as the message broker for all of the connected PSAPs.

4.91.2 Proposers should outline their strategy for supporting continued CAD operation and functionality. This shall be accomplished via interface to the existing Northrup Grumman system or by replacing the system. Proposers shall indicate their cost for interface application development to the present Northrup Grumman Message Switch or the cost of a replacement system. Proposers shall state their experience with, and any successful integration with similar CAD message switches.

4.92 LMR System Statement of Work

4.92.1 The Proposer shall be responsible for providing a complete and functional system, with full system design, implementation, optimization and testing encompassing the following subsystems:

4.92.1.1 800 MHz P25 Phase II (TDMA) multi-site, simulcast and multicast technology, trunked radio system
4.92.1.2 Portable, mobile and control station radio subscriber units
4.92.1.3 Licensed 6 GHz/11 GHz digital microwave transport system
4.92.1.4 Network connected IP-based dispatch console operating positions at multiple locations

4.92.2 The Proposer shall be responsible for providing the following project components and services:

4.92.2.1 Engineering and System Design
4.92.2.2 Radio site design and construction, with leaseback of facilities and eventual assignment of leases to King County. Furnishing and installing all radio and microwave system equipment and ancillary systems, including temporary facilities as needed for system transition

4.92.2.3 Project Management
4.92.2.4 Software installation and programming
4.92.2.5 Firmware installation and configuration
4.92.2.6 Training
4.92.2.7 Acceptance testing, including coverage testing
4.92.2.8 Migration and transition plan and execution
4.92.2.9 Warranty and Post Warranty Support Services
4.92.2.10 Mobile Radio Installation
4.92.2.11 Control Station installation
4.92.2.12 Portable Radio Programming and Testing
4.92.2.13 Initial Subscriber Radio template creation and programming
4.92.2.14 Full test of subscriber equipment to manufacturer specifications (a test plan shall be developed and submitted for Owner approval)
4.92.2.15 Barcode label encoding of all equipment make, model and serial number (S/N) for inventory purposes

4.93 Project Phases

4.93.1 Proposers shall follow an implementation approach that includes the following key phases:
4.93.1.1 Project Initiation through Notice To Proceed (NTP) and Kickoff Meeting
4.93.1.2 Design Review conducted in two phases:
4.93.1.3 Fixed infrastructure design effort conducted pre-contract
4.93.1.4 Final Design Review conducted post contract
4.93.1.5 Order Processing and Manufacturing
4.93.1.6 Factory Configuration (Staging)
4.93.1.7 Factory Acceptance Testing
4.93.1.8 Equipment Installation
4.93.1.9 Systems Integration and Optimization
4.93.1.10 Field and Coverage Acceptance Testing
4.93.1.11 Technical and Operational Training
4.93.1.12 System Cutover
4.93.1.13 Project Finalization
4.93.1.14 Project Documentation
4.93.1.15 Warranty Support
4.93.1.16 Post Warranty Support Period
4.94  Project Initiation

4.94.1  Proposer Project Manager shall initiate the implementation process. Proposer shall conduct the project initiation meeting(s) with King County representatives.

4.94.1.1  Introduction of the Proposer and King County Project Managers as the single point of contact with authority to make routine project decisions

4.94.1.2  Introduction of all project team participants

4.94.1.3  Review of the roles of the project participants to identify communication flow and decision-making authority between participants

4.94.1.4  Review of the overall project scope and objectives

4.94.1.5  Review of the resource and scheduling requirements.

4.94.1.6  Review the draft project schedule addressing milestones and key deliverables

4.94.1.7  Review of the Project Management Plan and processes

4.94.2  This task is considered complete when the Project Kickoff Session has been held with Proposer and King County representatives in attendance, and when project scope, schedules, procedures, roles and responsibilities have been documented and agreed upon.

4.95  Detailed Design Development and Review

4.95.1  After the kick off meeting, Proposer shall meet with King County’s project team to achieve written agreement on the final system design, identify any special system or product requirements and their impact on system design or implementation, identify final radio subscriber unit counts and configurations, and refine the system implementation plan and plan documentation.

4.95.2  Proposer shall provide, at a minimum, the following documents to King County for its review and approval:

4.95.2.1  Document Index

4.95.2.2  Project Schedule

4.95.2.3  Statement of Work

4.95.2.4  System Description

4.95.2.5  Final Design Documentation

4.95.2.6  Final Design of Backhaul System

4.95.2.7  Final Design of Land Mobile Radio System *

4.95.2.8  Equipment Lists

4.95.2.9  Coverage Maps based on Final Site Selection and Quantity

4.95.2.10  Frequency Plan

4.95.2.11  FCC License Applications

4.95.2.12  Loading Analysis

4.95.2.13  System IP Plans

4.95.2.14  Connectivity Plan for Tunnel Radio Systems
4.95.2.15 Microwave System Description
4.95.2.16 Microwave Network Maps
4.95.2.17 Microwave Path Analysis for each Hop
4.95.2.18 Microwave Traffic Engineering and IP Network Plan
4.95.2.19 MPLS Configuration Plan
4.95.2.20 Site Layout Drawings
4.95.2.21 Shelter Floor Plan Drawings
4.95.2.22 Rack Elevation Drawings
4.95.2.23 System Block and Level Diagrams
4.95.2.24 Power Consumption Data (based on measured values)
4.95.2.25 Site Heat Output Data (based on measured values)
4.95.2.26 Antenna System Diagrams, including Combiners, Tower Top Amplifiers and Receiver Multicoupler Systems
4.95.2.27 Tower Elevation / Antenna Placement Diagrams
4.95.2.28 Site Alarm Definition
4.95.2.29 Factory Acceptance Test Plan (FATP)
4.95.2.30 Backhaul System Factory Acceptance Test Plan
4.95.2.31 Equipment Inspections (100%)
4.95.2.32 Measured Values (sampled)
4.95.2.33 Functional Testing
4.95.2.34 Field Acceptance Test Plan (FATP)
4.95.2.35 Final Implementation Plan *
4.95.2.36 Land Mobile Radio System Factory Acceptance Test Plan *
4.95.2.37 Land Mobile Radio System Field Installation, Inspection and Test Plan *
4.95.2.38 System Optimization Plan
4.95.2.39 Backhaul System Field Test Plan
4.95.2.40 Installed Equipment Inspections (100%)
4.95.2.41 Measure Values (100%)
4.95.2.42 Functional Testing
4.95.2.43 Subscriber Test Plan
4.95.2.44 Mobile Radio Installation Plan
4.95.2.45 Pilot Test Plan
4.95.2.46 Functional and Operational System Test Plan
4.95.2.47 System Voice Group Mapping
4.95.2.48 Radio System Availability Test Plan
4.95.3 During this period, Owner shall:

4.95.3.1 Finalize site acquisition, zoning and permitting and Owner responsibilities for additions and improvements to current private sites and all government sites

4.95.4 During this period, the Proposer shall:

4.95.4.1 Finalize site acquisition, zoning and permitting and Proposer responsibilities for construction, additions and improvements to new private sites.

4.95.4.2 Provide a radio site “ready” indication to Proposer by the date specified in the Project Schedule

4.95.5 This activity is complete when all documentation and detailed documents associated with this phase have been delivered to Owner, reviewed and approved by Owner, and signed by the designated representative from Owner. After acceptance, Proposer shall schedule all factory orders for shipment to meet the approved project schedule. Each of the specific design activities associated with developing these design documents is described in the following section. Some Detailed Design Development activities shall involve the review and finalization of multiple documents.

4.96 Finalize Project Schedule

4.96.1 The objective of this task is to finalize the preliminary Project Schedule contained in the Proposal and as amended in the Project Initiation meeting. This finalization shall be based on the requirements identified in the Detailed Design Development Review and shall take into consideration the project objectives, plans, schedules, activities, approvals, priorities and interdependencies among tasks. The Project
Schedule shall be finalized at the end of the Detailed Design Development and Review process and mutually agreed upon between the Parties. The resulting document defines the specific project tasks to be completed and verifies the final Project Schedule for each subsystem to be implemented.

4.96.2 The accepted Project Schedule shall become the governing Project Schedule incorporated into the contract, and is subject to change only upon mutual agreement of Proposer and King County. The acceptance of the project schedule shall be the final activity of Detailed Design Development and Review process.

4.97 Prepare Final Frequency Plan and FCC License Applications

4.97.1 Based on the existing Frequency Plan provided by the Owner, the Proposer shall develop and provide a Frequency Plan for the PSERN. The Proposer shall prepare any necessary licensing documentation, including engineering documents if required, secure Owner signatures for all LMR and Microwave applications, and submit for regional coordination.

4.97.2 The Proposer shall present the application package to regional coordination bodies, including Region 43 and the Washington State SIEC, as well as any other local or regional approvals body. Once local coordination is approved, The Proposer shall submit applications to national level coordination bodies. All application and coordination costs shall be paid by Proposer.

4.98 Finalize Radio System Loading Analysis

4.98.1 Based on the newly proposed Frequency Plan, the Proposer shall consult with the Owner to finalize loading requirements for the PSERN.

4.99 Finalize Microwave System Design

4.99.1 Proposer shall provide a comprehensive microwave system design meeting the requirements established by Owner. This design shall serve as the baseline design. During the detailed design development process, Proposer and Owner shall work together to finalize the microwave system design for the PSERN.

4.100 Finalize MPLS Network Design

4.100.1 Proposer shall provide a comprehensive MPLS network design meeting the requirements established by the Owner. This design shall serve as the baseline design. During the detailed design development process, Proposer and Owner shall work together to finalize the MPLS network design for the PSERN.

4.101 Finalize Space, Power and HVAC Requirements

4.101.1 Proposer shall finalize space, power and HVAC requirements for PSERN based on the agreed upon design. Proposer shall provide floor layout and rack elevation drawings with associated transition plans for each site. Proposer shall provide actual measured power consumption and heat output data rather than specification sheet data in order to comply with the requirements of this task. Prior to finalization of the space, power and HVAC requirements,

4.101.2 Proposer shall have completed the system design including defining the number of sites and their location, the number of channels at each site, the overall system configuration and architecture and must the configuration shall be jointly agreed upon by Owner and Proposer.
4.102 Finalize Transition Plan

4.102.1 A preliminary transition plan shall be provided as part of the Proposal. To ensure a smooth transition from the existing radio system to the new radio system, a detailed transition plan shall be finalized during the Detailed Design Development and Review, to transition to the new radio system. As the implementation proceeds, further detail shall be added by Proposer to the transition plan.

4.102.2 Individual cutover plans shall be developed for individual systems and sub-systems including fixed radio and microwave network equipment, dispatch operations, user radio fleets, and radio sites and towers, as well as other systems.

4.103 Finalize Acceptance Test Plan (ATP) Procedures

4.103.1 Draft acceptance test plans shall be provided in the Proposal. Proposer shall finalize ATP documents in the Detailed Design Development and Review to provide the required procedures to be used for testing the functionality and performance of the system for Owner approval. The ATP documents establish the sole framework for system acceptance. The tests shall validate the functional performance of the system. The ATP includes the acceptance criteria to ensure the equipment operates according to the specifications, design and standards identified in the Proposal.

4.104 Site Preparation and Readiness

4.104.1 As specified in the RFP, Proposer has designed the system to utilize the best selection of sites as specified in the RFP, while also adding facilities as required to meet the coverage requirements specified by Owner. Because site development responsibilities lie with both Proposer and with Owner, Proposer shall be flexible in working with the Owner to determine site readiness.

4.104.2 For a site to be considered “ready,” it must have adequate room in an existing building or shelter to accommodate the equipment to be installed, along with electrical service and internal power distribution in place.

4.105 Planning for Site Access

4.105.1 King County shall provide reasonable site access for scheduled site walks, installation, optimization, system troubleshooting and performance of acceptance testing for the duration of the project. Site access is dependent upon weather, not all sites are accessible at all times. Owner representative escort is required at all sites. King County Project Manager and Proposer Project Managers shall coordinate and schedule access to each site 72 hours in advance of desired visit. Owner shall use its best efforts to provide site access.

4.106 Subscriber Fleet Mapping, Templates, and Programming

4.106.1 Proposer shall work with Owner to develop the fleet map for the system and the participating agencies. This work takes place during the Detailed Design Development activity and extends beyond its completion. Proposer shall conduct meetings with Owner to define fleet mapping, discuss effective organization of talkgroups, and detail how to set up the fleet map to operate in the system.

4.106.2 Based on the system fleet map, the configurations for the consoles (talkgroups by operator position, conventional and auxiliary interfaces), logging talkgroups and trunked system controller database (talkgroup and radio ID ranges) shall be developed by Proposer for programming into the fixed equipment. All elements of
subscriber radio programming shall be done using only Owner approved and signed fleet map and programming templates.

4.106.3 During system implementation, Proposer shall support and guide Owner in its efforts to define the fleet mapping and programming requirements. The infrastructure equipment, mobiles, portables, and any other fixed network equipment in the system shall be configured based on this fleet map. Proposer shall include development of all programming templates for the subscriber equipment.

4.106.4 All Fleet Mapping data is considered to be security sensitive information. All personnel assigned to System Fleet Mapping and Template creation tasks shall be required to undergo a background investigation and sign an individual Non-Disclosure Agreement (NDA).

4.107 Order Processing and System Manufacture

4.107.1 After the Contract Design Review and subsequent contract execution, Proposer shall process orders for equipment and begin equipment manufacturing.

4.108 Factory Staging

4.108.1 Proposer shall provide factory staging for all major fixed-end equipment, including the microwave and MPLS networks and a representative sampling of subscriber units in the Proposal.

4.108.2 Proposer shall assemble the full system hardware at a single location. Physical setup, racking and location of hardware shall comply with Owner approved equipment layout plans. Cables shall be cut and labeled with information to clarify interconnection for field installation. Cables shall be cut to fit the room layout plan specifications. All provided inter-rack and inter-equipment cables shall have connectors attached and tested. No DC power systems shall be staged at the factory location.

4.108.3 After assembling the equipment, Proposer’s Staging Technicians and Field Activities Managers shall power up the equipment, load software, set levels, program, configure and optimize the equipment. System parameters shall be set according to inputs from the Proposer design team. System software and system features shall be tested and validated. All system levels shall be set according to specifications to verify proper end-to-end connectivity. These settings shall be recorded and documented to provide baseline information to the field integration team.

4.108.4 The system shall be exercised while in factory staging which shall allow testing and burn-in of components and boards for proper operation as a complete system prior to shipping to Owner. Once the system or subsystem has been assembled, optimized, and integrated as a complete working unit, the system shall be tested according to the Factory Acceptance Test procedures.
4.109 Factory Acceptance Testing

4.109.1 Upon satisfactory completion of tests, Proposer shall coordinate with Owner for a factory visit to participate in system testing. This visit shall provide Owner with the opportunity to see the equipment assembled and working as an integrated system and to test in a hands-on manner, most functionality and features of the communication system that are capable of operation in a factory environment. Factory acceptance testing shall comprise of four (4) elements. These are:

4.109.1.1 100% Inspection by Proposer and County of all staged fixed infrastructure

4.109.1.2 5% Selective measurement of all equipment levels, settings and input/output values by Proposer and review of all measured values by Owner. Measurements shall be witnessed by Owner representative technical staff.

4.109.1.3 Functional testing of all features present in the Proposal and purchased by Owner as a joint activity between the Owner and Proposer.

4.109.1.4 Testing of alternate vendors radios on supplied P25 system

4.109.2 At completion of Factory Acceptance Testing, Proposer shall inventory the equipment. Proposer shall update the inventory database with this information to assist in tracking upon delivery to the field.

4.110 Fixed Network Equipment Installation

4.110.1 Proposer shall be responsible for warehousing and delivery of equipment to the sites. Proposer shall be responsible for all installation of proposer furnished equipment and shall have responsibility for bolting the racks to the floor, providing earthquake bracing as per Seismic Zone 4, and ensuring that all equipment is properly secured. All equipment shall be installed in a neat and professional manner, employing a standard of workmanship consistent with the Proposal and specifications and standards referenced in the RFP.

4.110.2 Infrastructure and antenna systems shall be installed per quantities and at locations identified in the Proposal, and subsequent Owner approved design changes. Proposer shall cable the equipment and furnish and install radio and microwave antenna systems and provide any required cable management materials including entry boots, tower cable boots or other cable management items, and all required antenna mounts.

4.110.3 Proposer shall deliver, bolt to the floor and provide earthquake bracing for the DC power system. Proposer shall connect the DC power to the AC power panel provided by Owner. Proposer shall perform startup services on the DC power equipment.

4.110.4 AC and DC primary power wiring shall not be exposed and shall be installed within conduit as per National Electrical Code, and any applicable Local Codes.

4.110.5 For installation of the fixed equipment at the various sites, Proposer shall furnish all cables for power, audio, control, radio and microwave transmission to connect the supplied equipment to the power panels or receptacles and the audio/control line connection point. All cabling shall be cut to length, properly connected and terminated per Owner installation standards and clearly labeled at both ends.
4.110.6 All punch blocks used shall be 66 block style. All associated punch block connections shall be properly labeled. All cabling, port assignments, and punch block connections shall be recorded into the final system as-built documentation.

4.110.7 Proposer shall ground and bond all provided equipment during installation and Proposer is responsible for connecting all equipment to the common ground system at the existing facilities. All cabinets, racks, enclosures, telephone circuit surge protectors, and transmission line surge protectors provided shall be connected to the single point ground. Proposer shall connect all ground connections using approved non-reversible crimp or clamp connections.

4.110.8 During field installation of the equipment, any required changes to the installation shall be noted and assembled with the final as-built documentation of the system. The as-built documents shall be provided at the end of the project along with the maintenance and operator manuals. Upon completion of installation, Proposer shall perform final site inspections to verify proper physical installation and operational configurations of each individual site.

4.110.9 Proposer is responsible to provide, install, optimize and test the new microwave network and MPLS network equipment to enable proper function of the P25 trunked system.

4.110.10 Proposer shall remove and dispose of decommissioned equipment associated with the existing Owner trunked radio system.

4.111 Mobile Installation and Radio Programming

4.111.1 Proposer shall install mobile radios in vehicles and control stations based upon a mutually agreed upon schedule. Installation locations shall exist at multiple locations across King County. All Owner mobile installation locations shall have sufficient space, lighting, heating, adequate shelter, and power for Proposer to perform the installation work.

4.112 System Optimization

4.112.1 Proposer shall verify that all equipment is operating properly and that all levels are properly set, once installation in the field is complete. Proposer shall optimize each subsystem individually. All audio and data levels shall be checked to verify factory settings. All radio equipment shall have forward and reflected power checked by Proposer after connection to the antenna systems, to verify that they meet the FCC requirements and are within Proposer design tolerances. All communication interfaces between devices shall be verified for proper operation. All features and functionality shall be tested by Proposer to ensure that they are functioning according to the manufacturer’s specifications and per the final configuration established during system staging.

4.113 Inter Sub-System Interface (ISSI) Configuration, Link Coordination and Testing

4.113.1 Subject to agreements to be established between the Owner and other jurisdictions within the State of Washington, the Proposer shall coordinate, install, terminate, properly configure, optimize and demonstrate ISSI connectivity between the PSERN and other P25 radio systems. Proposer shall connect to each of the outside systems as specified in the RFP and in the Proposal. Proposer shall coordinate such work with external system, its vendors and subcontractors to the greatest extent possible. ISSI functionality shall be functional at time of system acceptance.
4.114 System Training

4.114.1 Technician, Dispatcher, and subscriber radio user training shall be provided for technical personnel, dispatcher personal, and end user per the selected training courses identified in the Proposal. Training shall take place at various locations within King County. The optimum timing of when training takes place shall be established by the Proposer.

4.114.2 Proposer shall conduct courses to thoroughly train Owner radio system users and dispatch personnel on use of the system, and Owner technical personnel on operation and support of the system.

4.114.3 Depending upon the length of time to final system acceptance, in-the-field refresher technical training on the implemented system version may be required of the Proposer.

4.115 Field Acceptance Tests

4.115.1 Field acceptance testing shall comprise of three (3) elements. These are:

4.115.1.1 100% Inspection by Proposer and Owner of all installed fixed infrastructure

4.115.1.2 100% Measurement of all equipment levels, settings and input/output values by Proposer and review of all measured values by Owner. Some measurements shall be witnessed by Owner representative technical staff.

4.115.1.3 Functional testing of all features present in the Proposal and purchased by Owner as a joint activity between the Owner and Proposer.

4.115.2 System acceptance tests shall be performed when the system optimization is complete. The field acceptance tests verify the full system functionality. These tests shall verify the entire system in operation, including radio system roaming and subscriber affiliation.

4.116 Coverage Acceptance Tests

4.116.1 Coverage Acceptance Tests shall be performed when the RF site and control equipment installations and optimization are complete. Coverage Acceptance Tests verify the coverage performance of the system, based upon the Approved Coverage Acceptance Test Plan.

4.117 System Operational without Significant Flaw or Defect Prior to System Acceptance

4.117.1 The installed system shall be operational with no failures for a minimum of sixty (60) consecutive calendar days in order for the system to be ready for user agency transition. Radio traffic shall be generated by system testers and through use of patches to existing radio systems. System operation shall be closely monitored for this period. Significant flaws or defects shall require resolution by Proposer. Failures between fifty-sixth (56th) and sixtieth (60th) day shall add fifteen (15) days to the operational test period. Failure on or before the fifty-fifth (55th) day shall restart the full sixty (60) day test interval.

4.118 Cutover to New System Operations

4.118.1 The existing Owner radio system and existing microwave network shall need to remain functional to the greatest extent possible through system transition without
significant loss of dispatch features and radio user communications capability. The
following are required minimal functionality through the transition process:

4.118.1.1 Audio shall pass between the existing and new systems

4.118.1.2 Emergency signaling shall be provided over each network. Emergency
indications shall pass between systems.

4.118.1.3 Unit ID signaling shall be provided over each network. Unit IDs shall
pass between systems.

4.118.2 Solutions that can provide emergency signaling and unit ID to function
simultaneously on both existing and new infrastructure are required. A possible
upgrade option exists to add a 3rd ISSI license for ISSI.1. The costs associated
with this upgrade shall be addressed by Owner.

4.118.3 Proposers shall develop a comprehensive series of Cutover Plans that
demonstrate their strategy for transitioning the existing Owner radio system to the
new PSERN. Proposers are cautioned that transitions that include the reuse of
existing 800 MHz radio spectrum must detail the methodology to be used for the
transition process in the Proposal.

4.118.4 Multiple cutover plans are required because of the wide range of systems being
replaced as part of the transition. The Cutover Plans shall be finalized working
directly with Owner’s Project Manager, Owner user agencies and departments and
communications center dispatchers and supervisors. These meetings shall
address how to deal with the technical issues, communication impact to users,
and general operational issues and planning that need to be accommodated for
Owner’s various agencies.

4.118.5 The mutually agreed upon methodology for cutover shall ensure that a safe,
effective and efficient transition occurs from the old radio system to the new
system with minimum impact on user operations. The Cutover Plan shall detail
timelines, sequence of events, resources involved, potential downtime, operational
details, which departments move to the new system, and the order in which they
will migrate. The Cutover Plan shall also detail how communications will occur for
each department during the transition process. A Cutover Plan timetable listing the
chronological orders and time frames also shall be developed. The Cutover Plan
shall consider, as a minimum, the following components:

4.118.5.1 Site equipment and RF system cutover (spectrum management, and
tower and equipment space considerations)

4.118.5.2 Site power-management strategy (managing peak loads with both
systems active)

4.118.5.3 Dispatch console upgrade and cutover

4.118.5.4 Radio subscriber fleet cutover approach (install, de-install,
programming)

4.118.5.5 Site "turn up" sequencing

4.118.5.6 Other considerations not specifically included above

4.118.5.7 Work outside of normal hours (incl. late nights and weekends) when
system traffic is non-peak.

4.118.5.8 Defined periods of expected outages
4.118.5.9 Defined expected risks to operations (potential service interruptions) based on the transition plan

4.118.6 The use of Gantt chart or flowcharts to represent phases and sequencing of a transition strategy is requested.

4.118.7 Proposer shall include a fall back plan should there be a need to abort the cutover and restore Owner’s operations to the legacy radio system.

4.119 System Acceptance

4.119.1 Refer to the definition language of System Acceptance located in Part B.

4.120 Disposal of Dismantled SmartZone™ Radio System

4.120.1 Proposer shall have responsibility for removal and disposal of the decommissioned SmartZone™ system components, as well as de-commissioned radio subscriber units and other ancillary equipment removed as part of the system upgrade and replacement.

4.121 Project Finalization

4.121.1 Proposer shall work with the Owner to resolve punch-list items documented during system installation and testing. In order to meet all criteria for final system acceptance, the Owner shall approve resolution of all punch list items.

4.122 System Design Documentation

4.122.1 Proposer shall provide documentation of the system configurations, physical installation, and system testing.

4.122.2 Documentation shall be created and updated during the project.

4.122.3 Documentation shall be provided as both printed copies, in sufficient quantities to meet County requirements, and as PDF documents.

4.122.4 Documentation shall be provided in County maintainable formats (MS Office, Visio, AutoCAD or other formats) or maybe be provided in PDF format where the provided documentation depends on Proposer-proprietary formats.

4.122.5 Electronic versions of Proposer-proprietary formats shall be provided both in a viewable format and in the documents standard format.

4.123 Design Documentation

4.123.1 Proposer shall create or update the following standard documents during the design phase for both the conventional and trunked systems:

4.123.1.1 Document Index
4.123.1.2 Project Schedule
4.123.1.3 Statement of Work
4.123.1.4 Radio System Description
4.123.1.5 Coverage Maps based on Final Site Selection and Quantity
4.123.1.6 Frequency Plan
4.123.1.7 Loading Analysis
4.123.1.8 Radio System IP Plan
4.123.1.9 Microwave System Description
4.123.1.10 Microwave Network Maps
4.123.1.11 Microwave Path Analysis for each Hop
4.123.1.12 Microwave IP Network Plan
4.123.1.13 MPLS Configuration Plan
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4.123.1.22 Site Alarm Definition
4.123.1.23 Equipment Lists
4.123.1.24 Factory Acceptance Test Plan (FATP)
4.123.1.25 Equipment Inspections (100%)
4.123.1.26 Measured Values (sampled)
4.123.1.27 Functional Testing
4.123.1.28 Field Acceptance Test Plan (FATP)
4.123.1.29 Installed Equipment Inspections (100%)
4.123.1.30 Measure Values (100%)
4.123.1.31 Functional Testing
4.123.1.32 Coverage Acceptance Test Plan (CATP)
4.123.1.33 Training Plan
4.123.1.34 Transition Plan
4.123.1.35 System administrator documentation and system programming parameters

4.124 Factory Staging Documentation

4.124.1 Proposer shall create or update the following documents at the conclusion of system staging:
4.124.1.1 Programming templates
4.124.1.2 Interconnection drawings up to Proposer demarcations
4.124.1.3 Manufacturer’s standard operator manuals
4.124.1.4 Re-assembly instructions
4.124.1.5 Interconnection cable description and inventory
4.124.1.6 Printout of equipment parameters
4.124.1.7 Inventory with serial numbers and installation reference
4.124.1.8 Software/firmware version numbers
4.124.1.9 Manufacturer’s standard technical manuals

4.125 As-Built System Documentation

4.125.1 Proposer shall supply as-built documentation for all supplied systems. Documentation shall be provided as both printed copies and as PDF documents. Documentation shall be provided in electronic format using portable drives. Owner maintainable native formats (MS Office, Visio, AutoCAD or other formats) or PDF’s where the provided documentation depends on Proposer-proprietary formats.

4.125.2 One (1) full copy of each site’s system as-built drawing set shall be left at each site along with a copy of all applicable equipment and system manuals as a permanent reference. Seven (7) master system as-built documentation sets in seven (7) portable drives, and in printed form in three (3) ring binders, and copies of all applicable equipment and system manuals shall be provided for central retention, along with softcopies of all documents in both their native formats and as PDF’s.

4.125.3 A final, fully integrated as-built drawing set shall be provided 90 days following completion of the project and prior to issuance of final payment.

4.125.4 The documentation shall, at a minimum, consist of:
   4.125.4.1 Standard Equipment Manuals
   4.125.4.2 System drawings:
   4.125.4.3 Fixed Equipment Documentation
   4.125.4.4 Plan and elevation views of the equipment installation at the radio site
   4.125.4.5 Equipment inter-cabling diagrams for each site
   4.125.4.6 Demarcation wiring lists
   4.125.4.7 Programming and level setting data sheets
   4.125.4.8 Equipment by site
   4.125.4.9 Key access procedures
   4.125.4.10 Site inventory lists
   4.125.4.11 Remote sign-on procedures and passwords
   4.125.4.12 Software versions and equipment wiring by equipment site
   4.125.4.13 Radio Licenses
   4.125.4.14 Field ATP test sheets and results
   4.125.4.15 Maintenance Records
   4.125.4.16 Warranty information
   4.125.4.17 Service Provider
   4.125.4.18 Equipment Manuals

4.125.5 Proposer shall provide equipment manuals covering both standard and optional features. Manuals shall be provided in sufficient quantities to meet County requirements. Manuals shall be provided as PDF documents, and where available, in printed copies.
5 LMR SUBSCRIBERS

5.1 Technical Introduction

5.1.1 The desired characteristics for first responder radios includes the following key elements:

5.1.1.1 Given their cost, and the critical mission of the radio users, radios must be durable

5.1.1.2 First responder radios must be emergency alert and encryption capable

5.1.1.3 Buttons and knobs must be functional even when the user is wearing Personal Protective Equipment (PPE)

5.1.1.4 For certain groups of users who operate in hazardous environment, radios must be available for purchase is intrinsically safe configurations

5.1.1.5 Battery rating must be suited to the conditions found in public safety use, such as extended receive times and reduced transmit times

5.1.1.6 Radios must reduce or eliminate area noise that interferes with a communication sequence (acoustic interference such as ambient noise impacting P25 radio audio quality)

5.1.1.7 Portable radios will ideally have a large, highly legible display on front of the radio, as well as on the top of the radio

5.1.1.8 Radios must operate without harmful RF interference in all but the most unusual circumstances.

5.1.1.9 Radio must provide the ability to “scan” between talkgroups (where such capability is operationally approved)

5.2 General Requirements

5.2.1 The Proposer shall provide details regarding tiers of equipment offered. All model tiers proposed shall conform to TIA-102 Class A (for P25 operation) and TIA-603 (for analog operation) radio specifications and shall support 700/800 MHz operation. Proposers shall also provide a list showing other manufacturer’s subscriber units (i.e. make, model) that have been tested on the system and approved for use.

5.3 Performance Requirements

5.3.1 Subscriber equipment to be used on the PSERN shall conform to TIA-102 “Class A” for digital operation and TIA-603 “Class-A” for analog operation radio performance specifications and shall be available in multiple product tiers for use by first responder agencies.

5.3.2 Product tiers shall be categorized by Proposers upon varying levels of electronic and physical construction, and varying levels of human/user interface. Examples include:

5.3.2.1 TIA-102 CAAB-B receiver and transmitter performance specifications

5.3.2.2 Levels of mechanical design and ratings (ex. FM intrinsically safe, IP/IPX ratings, etc.)

5.3.2.3 Absence or presence of user buttons, keypads, and or operational displays
5.3.3 With the express written permission of the Owner, additional users from other King County agencies may use the system, and will have the responsibility for funding their participation. These agencies will generally elect to utilize mid- or low-tier products. Based on this range of requirements, Proposers shall propose a range of subscriber radio products that meet the anticipated range of requirements for the system.

5.4 Required Functionality

5.4.1 Radio subscriber equipment proposed for use on the PSERN shall support group, individual, dispatch, system-wide, network-wide and emergency calls. Equipment shall also meet or exceed Mil Spec 810D, E and F for low pressure, high temperature, low temperature, shock, humidity, salt fog, and vibration.

5.4.2 In addition, the Proposer shall detail the following with regards to their proposed radio subscriber equipment:

5.4.2.1 Roaming characteristics
5.4.2.2 Evidence of FCC Part 90 Type Acceptance. Other FCC Rule Parts where applicable to VHF operation in multiband radios
5.4.2.3 Conformance to TIA-102 (latest edition) Class A performance specifications for digital operation
5.4.2.4 Conformance to TIA-603 (latest edition) Class A performance specifications for analog operation
5.4.2.5 Compliance to Applicable MIL Spec 810 standards
5.4.2.6 Encryption modes supported for first responder radios
5.4.2.7 Supported P25 functionality
5.4.2.8 Standard and Optional User Accessories
5.4.2.9 GPS location and tracking capability via internal option or external interface
5.4.2.10 Support for Intrinsically Safe (IS) and Factory Mutual (FM) option. Proposers should also note any impact to subscriber equipment and infrastructure design resulting from modifications to the IS and FM requirements (e.g. reduced RF power output requirements)
5.4.2.11 Support for low profile or high performance (dB gain) antenna options
5.4.2.12 Support for covert surveillance adaptors that support an earpiece and microphone/PTT
5.4.2.13 Support for standard or optional color LCD
5.4.2.14 Support for audio playback/voice announcement of operating modes via user- or pre-recorded sound files.

5.5 700 MHz/800 MHz as Primary Requirement

5.5.1 All radio subscriber offerings shall be capable of operation on both 700 and 800 MHz supporting APCO P25 Phase 2 (TDMA) and Phase 1 (FDMA) trunked operation.
5.6 VHF Capability on Limited Quantity Of Radios (TBD by Owner)

5.6.1 Various first responder agencies within King County and in neighboring counties utilize VHF for primary first responder communications. The most significant agency is the Washington State Patrol (WSP) and other Federal Agencies. Interoperability at the radio subscriber level is desirable for a limited subset of PSERN users.

5.6.2 Due to the high cost of premium-tier multi-band radios, it is envisioned that limited quantities of these special capability units might be cached and later fielded in limited numbers to team leaders or incident commanders for tactical interoperable communications use. The expectation is that multi-band radios shall support VHF and 700/800 MHz operation, and are desirable for specific users within King County.

5.6.3 Note: There is currently no requirement for UHF operation as part of a multi-band subscriber radio solution.

5.6.4 Proposers shall provide details regarding any multi-band P25-compliant mobile and/or portable subscriber equipment offered as part of this RFP. These multi-band radios shall be priced as an option in the Proposer’s proposal. In addition, Proposers shall provide a list of multi-band radio subscriber units that have been tested on their system and certified to operate without impairment on their system infrastructure.

5.7 Quantities by Radio Type

5.7.1 Refer to Appendix 11 Subscriber Matrix for the types and quantities of radios required for first responder and non-first responder agencies. These quantities shall be used for pricing purposes and are subject to adjustment in the post-contract detailed design process.

5.8 Proprietary or Proposer-Specific Features or Functionality

5.8.1 The Proposer shall declare any functions that may not be expected to work for each tier of the subscriber radios from other manufacturers on the system being proposed. Proposers must detail both the benefits of the features or functionality being proposed via a proprietary signaling or unique extension of the P25 CAI protocol, as well as the effects and impact on overall user operation, assuming a mixed manufacture fleet of radio subscriber units.

5.9 Encryption and Over the Air Re-Keying (OTAR) Requirements

5.9.1 Digital voice encryption capability supporting AES-256 encryption shall be provided for law enforcement and medical first responder radios. Encryption schemes requiring the physical modification of subscriber equipment to enable are unacceptable. The system should support over-the-air-re-keying (OTAR) of mobile and portable radios using the Project 25 OTAR standard when the standard suite is completed. Proposers shall elaborate on the requirements to implement these features, to include:

5.9.1.1 Specifying if Encryption and OTAR are standard features or a cost option

5.9.1.2 Itemizing the required hardware, software or firmware to implement these capabilities
5.9.1.3 Disclosing the associated cost per subscriber unit and per system to implement these capabilities

5.9.1.4 Being completely software enabled, requiring no physical modification of the subscriber equipment

5.10 Other Voice Privacy or Encryption Schemes

5.10.1 AES-256 and DES-OFB encryption are required for all proposed first responder radios. Proposers offering digital voice privacy, scrambling, or other encryption schemes that are otherwise considered proprietary or non-standard shall disclose their suitability for implementation in the proposed radio system. Cost, benefit and performance analysis as well as impacts to system operation and user experience (i.e., transparency of operation, recovered audio quality, etc.) shall also be disclosed.

5.11 GPS Functionality

5.11.1 A subset of users on the PSERN may wish to implement the capabilities provided by encoding of GPS coordinate data onto transmission for asset location, officer safety and fleet management benefits. Subscriber radios with integrated GPS that can display coordinate information on the LCD is desirable.

5.11.2 Proposers shall outline the GPS position reporting capabilities of their offered radio subscriber units, to include:

- 5.11.2.1 Internal GPS receiver hardware options
- 5.11.2.2 Externally-connected GPS hardware options
- 5.11.2.3 Specialized or application-designed accessories exploiting GPS reporting capabilities such as enhanced LCD displays or software mapping applications
- 5.11.2.4 Tactical (simplex conventional) GPS location solutions

5.11.3 The Proposer shall also outline the effect on system-wide performance due to providing GPS encoded transmission or polling-based position reporting via control channel or dedicated data channels.

5.12 Accessories

5.12.1 Proposers shall provide a comprehensive overview of all available accessories per radio subscriber model offering basic or enhanced user experience for the radio operator. This shall include a functional description of each accessory, corresponding model or ordering number, and cost information.

5.13 Radio Subscriber Support of 802.11(Wi-Fi), Bluetooth™ or other Wireless Technology

5.13.1 The ability to utilize headsets (ear bud, bone conduction microphones, etc.) and reprogram or rekey a radio through a high-speed wireless link in close proximity to the radio is desirable. Radio subscriber equipment that offers built-in 802.11 (Wi-Fi), Bluetooth™ or other wireless technology to support external peripherals shall be disclosed. Proposers are requested to elaborate on any features, functionality or capabilities this technology adds and potential applications with respect to the PSERN. Proposers shall also disclose any proprietary implementations that would preclude the use of Bluetooth™ accessories from multiple vendors.
5.14 TIA-102.CAAA P25 Conformance Test Menu Access in Radio Subscriber Units

5.14.1 The ability to access the TIA/EIA-102.CAAA-defined test patterns via a user menu on the radio front panel is highly desirable to service and test P25 Radio Subscriber units in the field, or where use of a PC may not be practical. This shall allow a technician with a P25 enabled communications analyzer to perform test routines rapidly without the need of a connected PC. The test menu must be protected to prevent inadvertent activation by a user.

5.14.2 TIA-102.CAAA test patterns are generated by the subscriber unit or the communications analyzer depending upon the tested parameter and mode (trunking or conventional), as below:

- 5.14.2.1 Standard tone (1011 Hz) Test pattern
- 5.14.2.2 Calibration Pattern (5% BER)
- 5.14.2.3 Standard Pattern (0.153)
- 5.14.2.4 Symbol Rate (high deviation points)
- 5.14.2.5 Symbol Rate (low deviation points)
- 5.14.2.6 Silence
- 5.14.2.7 Busy
- 5.14.2.8 Idle
- 5.14.2.9 AFC

5.14.3 The Vendor shall disclose the ability of their proposed P25 Phase 2 (TDMA) radio subscriber units to allow menu access to the above functions for simplified conformance testing.

5.15 Radio Subscriber Maintenance, Test and Alignment

5.15.1 Radio technicians servicing the PSERN faces the task of maintaining a larger fleet of radio subscriber units implementing more complex digital technology with limited staff and resources. Exploiting capabilities to streamline this task utilizing built-in capabilities in trunked radio subscriber units or through the latest features in communications analyzer technology is highly desirable.

5.15.2 Proposer shall detail and outline technician accessible radio diagnostic menus available on offered subscriber units. Examples of this include FCC channel numbering, adjacent control channel status, etc.

5.16 Auto Test Capability

5.16.1 The implementation of software-based auto-tune and auto-test routines in popular P25-enabled communications analyzers to perform radio conformance testing as well as alignment routines based upon TIA/EIA-102.CAAA is a significant improvement in radio maintenance and troubleshooting efficiency. In addition to a simplified and repeatable testing regimen, an Auto-Tune and Auto-Test feature that creates a unique radio history file for managing and tracking performance and problems with radio subscriber units on a per-ID basis over the lifetime of the radio is invaluable. This capability is highly desirable for use by radio shop technicians servicing the PSERN.

5.16.2 The Proposer shall disclose the ability of their proposed P25 Phase 2 (TDMA) radio subscriber units to support automated testing and tuning/alignment. They
shall also recommend communications analyzers known to support Auto-Test and Auto-Tune. The following communications analyzer manufacturers are known to support this capability:

5.16.2.1 Aeroflex
5.16.2.2 General Dynamics
5.16.2.3 Anritsu

5.17 **PSERN Radio Subscriber Inventory Management System**

5.17.1 The future PSERN will have a significant quantity of high-value radio subscribers, accessories, and RF and IT infrastructure components. The Owner would greatly benefit from an inventory management system to facilitate tracking and disposition of all critical assets. The Proposer shall disclose any inventory management system they offer as a priced option. The offer shall also detail the technology used as the core method of data acquisition (ex. RFID, barcode scanning, etc.)

5.18 **Radio Subscriber General Requirements Specifications**

5.18.1 The Proposer shall provide details regarding tiers of equipment offered. All model tiers proposed shall conform to TIA-102 Class A (for P25 operation) and TIA-603 (for analog operation) radio specifications and shall support 700/800 MHz operation. Proposers shall also provide a list showing other manufacturer's subscriber units (i.e. make, model) that have been tested on the system and approved for use.

5.19 **First Responder Portable Radio Requirements**

5.19.1 The First Responder radio subscriber model is expected to be subjected to the most rigorous duty environment and issued to Fire, Rescue and Law Enforcement first responders. It is considered a “high-tier” radio from a feature standpoint and is expected to offer the user the highest level of functional capability.

5.19.2 The First Responder radio shall offer analog and digital operation, multi-channel or talk-group selector switch, transmit LED indicator, low battery warning, emergency button, industry standard data interface.

5.19.3 For display and user interface capabilities this model tier shall offer a full or enhanced multi-line display screen of a minimum of two (2) rows of twelve (12) characters each, full keypad, programmable function keys, user-accessible menus, and provide for a minimum of 512 channels/talk groups. It shall support multiple encryption key capability.

5.20 **General Government Portable Radio Requirements**

5.20.1 The General Government radio subscriber model is expected to be used in a less demanding operational environment than the First Responder role and will typically be issued to government administrative agencies, public works and utilities. It is considered a “middle-tier” radio from a feature standpoint and is expected to offer the user the functional capabilities commensurate with its intended role.

5.20.2 The General Government radio subscriber model shall offer analog and digital operation, multi-channel or talk-group selector switch, transmit LED indicator, low battery warning, emergency button, industry standard data interface.
5.20.3 For display and user interface capabilities this model tier shall offer a limited
display screen of a minimum of ten (10) characters, basic/limited keypad
programmable function keys, user-accessible menus, and provide for a minimum
of 256 channels/talk groups. It shall support a minimum of one (1) encryption key
capability.

5.21 Miscellaneous Agency Portable Radio Requirements

5.21.1 This radio subscriber model will be issued to qualified agencies having system
access but with a very limited operational environment. It will typically be issued to
municipal government agencies, school districts, and for administrative, volunteer,
or other events. It is considered a “lower-tier” radio from a feature standpoint and
is expected to offer the user basic functional capabilities.

5.21.2 The Miscellaneous Agency radio subscriber model shall offer basic standard
features such as analog and digital operation, multi-channel/talk group selector
switch, transmit LED indicator, low battery warning, emergency button, industry
standard data interface, and provide a minimum of 128 channels/talk groups.

5.22 Portable Radio Accessories

5.22.1 For reference purposes, the current portable radio equipment issued for PSERN
first responder agencies is listed below and includes:

5.22.1.1 Antenna

5.22.1.2 Two (2) high-capacity batteries (providing for at least 12 hours of
continuous operation based on a 6 second transmit, 6 second receive,
48 second standby cycle)

5.22.1.3 Standard speaker microphone (not the public safety microphone with
integrated antenna)

5.22.1.4 Public safety grade leather case with swivel and large belt loop

5.22.1.5 Single unit charger for battery

5.22.1.6 12 VDC vehicular charging option (ex. cigarette lighter adapter, mobile
mount for charger)

5.22.2 The Proposer shall outline in detail the additional optional accessories available
for use with their portable radio offering

5.23 Portable Radio Subscriber Unit Display

5.23.1 The Proposer shall detail size and dimensions of the LCD and the available icons
or characters in the LCD to communicate to the operator. As a minimum, the
following parameters shall be detailed:

5.23.1.1 Number of lines in display and the number of characters per line (ex. 3
x 14)

5.23.1.2 Decode and display of PTT ID in numeric or alphanumeric (alias)
format

5.23.1.3 Display of received signal level or strength in numeric format

5.23.1.4 Display of affiliated site ID

5.23.1.5 Indication of an active Emergency Call (EMER) on the selected talk-
group or channel
5.23.1.6 Indication of Wide Area Operation
5.23.1.7 Indication of control channel signal strength
5.23.1.8 Control channel Out-of-Range Indications
5.23.1.9 Indication (programmable, visual and audible) of site-limited, local area trunked communications (ex. site trunking)
5.23.1.10 Indication (programmable, visual and audible) of fail-soft operation (forced non-trunked, conventional)
5.23.1.11 Indication of battery charge condition
5.24 Portable Radio Environmental Specification

5.24.1 The Public Safety 700/800 MHz Portable Radio shall meet or exceed the following environmental specifications:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Parameter</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIL-STD-810F</td>
<td>Low Pressure</td>
<td>500.4/1,2</td>
</tr>
<tr>
<td></td>
<td>High and Low Temperature</td>
<td>501.4/1,2</td>
</tr>
<tr>
<td></td>
<td>Temperature Shock</td>
<td>503.4/1,2</td>
</tr>
<tr>
<td></td>
<td>Solar Radiation</td>
<td>505.4/2</td>
</tr>
<tr>
<td></td>
<td>Blowing Rain</td>
<td>506.4/1</td>
</tr>
<tr>
<td></td>
<td>Humidity</td>
<td>507.4</td>
</tr>
<tr>
<td></td>
<td>Salt Fog</td>
<td>509.4</td>
</tr>
<tr>
<td></td>
<td>Blowing Dust</td>
<td>510.4/1</td>
</tr>
<tr>
<td></td>
<td>Immersion</td>
<td>512.4/1</td>
</tr>
<tr>
<td></td>
<td>Vibration (min. integrity)</td>
<td>514.5/1, Category 24</td>
</tr>
<tr>
<td></td>
<td>Vibration (basic transportation)</td>
<td>514.5/1, Category 4</td>
</tr>
<tr>
<td></td>
<td>Shock (functional / basic)</td>
<td>516.5/1</td>
</tr>
<tr>
<td></td>
<td>Shock (transit / drop)</td>
<td>516.5/4</td>
</tr>
<tr>
<td>IEC 60529</td>
<td>Dust-tight and water jets</td>
<td>IP-65</td>
</tr>
<tr>
<td>U.S. Forest Serv.</td>
<td>Vibration (10-60 Hz)</td>
<td>USDA LMR standard, Section 2.15</td>
</tr>
<tr>
<td>TIA/EIA-603A</td>
<td>Shock</td>
<td>Paragraph 3.3.5.3</td>
</tr>
</tbody>
</table>

Table 5.24 Portable Radio Environmental Specification

5.24.2 Measurements are per TIA/EIA-603C, APCO P25 parameters are per TIA-102.CAAB-B
### 5.25 Portable Radio Transmitter Specification

5.25.1 The portable radio transmitter circuitry performance shall meet or exceed the following specifications:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range (MHz)</td>
<td>764-776, 794-806, 806-825, 851-869</td>
</tr>
<tr>
<td>RF Power Output</td>
<td>3 W. minimum</td>
</tr>
<tr>
<td>Frequency Stability (-30 ~ +60°C)</td>
<td>±1.5 ppm</td>
</tr>
<tr>
<td>Modulation Deviation (kHz)</td>
<td>2.5, 4.0, or 5.0</td>
</tr>
<tr>
<td>FM Hum and Noise (dB)</td>
<td>&gt;40 (non-NPSPAC)</td>
</tr>
<tr>
<td></td>
<td>&gt;38 (NPSPAC)</td>
</tr>
<tr>
<td></td>
<td>&gt;34 (12.5 kHz 700 MHz)</td>
</tr>
<tr>
<td>Audio Response (dB)</td>
<td>+1, -3</td>
</tr>
<tr>
<td>Spurious and Harmonics (dBm/dBc)</td>
<td>Meets FCC part 90; Emission mask &quot;G&quot; and &quot;H&quot; for 700/800 MHz</td>
</tr>
<tr>
<td>Frequency Separation (MHz)</td>
<td>Full bandwidth</td>
</tr>
<tr>
<td>Audio Distortion</td>
<td>&lt;2% at rated audio @1 kHz, 3 kHz deviation</td>
</tr>
<tr>
<td>P25 (C4FM) Modulation Fidelity (%)</td>
<td>&lt;5</td>
</tr>
<tr>
<td>P25 Adjacent Channel Power (dBc)</td>
<td>&gt;67</td>
</tr>
</tbody>
</table>

**Table 5.25 Portable Radio Transmitter Specification**
### 5.26 Portable Radio Receiver Specification

5.26.1 The portable receiver circuitry performance shall meet or exceed the following specifications:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency Range</strong></td>
<td>764-776, 794-806, 806-825, 85, 869</td>
</tr>
<tr>
<td><strong>Channel Spacing (kHz)</strong></td>
<td>12.5, 25.0 PLL Step</td>
</tr>
<tr>
<td><strong>Sensitivity (12 dB SINAD), (µV/dBm)</strong></td>
<td>0.25/-119</td>
</tr>
<tr>
<td><strong>P25 Reference Sensitivity (5% BER)</strong></td>
<td>0.25/-119</td>
</tr>
<tr>
<td><strong>Adjacent Channel Rejection @25 kHz (dB)</strong></td>
<td>&gt;75</td>
</tr>
<tr>
<td><strong>Adjacent Channel Rejection @12.5 kHz (dB)</strong></td>
<td>&gt;60</td>
</tr>
<tr>
<td><strong>P25 Adjacent Channel Rejection @12.5</strong></td>
<td>&gt;60</td>
</tr>
<tr>
<td><strong>Offset Channel Selectivity @ NPSPAC</strong></td>
<td>&gt;20</td>
</tr>
<tr>
<td><strong>Intermodulation (dB)</strong></td>
<td>&gt;72</td>
</tr>
<tr>
<td><strong>Spurious and Image Rejection (dB)</strong></td>
<td>&gt;72</td>
</tr>
<tr>
<td><strong>FM Hum and Noise</strong></td>
<td>&gt;37 (non-NPSPAC)</td>
</tr>
<tr>
<td></td>
<td>&gt;35 (NPSPAC)</td>
</tr>
<tr>
<td></td>
<td>&gt;31 (12.5 kHz 700 MHz)</td>
</tr>
<tr>
<td><strong>Frequency Stability (-30 ~ +60°C)</strong></td>
<td>±1.5</td>
</tr>
<tr>
<td><strong>Frequency Separation (MHz)</strong></td>
<td>Full Bandwidth/Band split</td>
</tr>
<tr>
<td><strong>Audio Output (mW)</strong></td>
<td>500</td>
</tr>
<tr>
<td><strong>Audio Distortion</strong></td>
<td>&lt;3% @ rated power</td>
</tr>
</tbody>
</table>

**Table 5.26 Portable Radio Receiver Specification**
5.27 Required Performance Levels of Subscriber Units

5.27.1 Subscriber units shall conform to Class A and be tested in accordance with the following sections of ANSI/TIA-102.CAAA-A1, and shall meet or exceed all of the minimal performance recommendations (or Class B requirements where applicable) as specified in ANSI/TIA-102.CAAB-A.

5.27.1.1 §2.1.4 Reference Sensitivity
§2.1.5 Faded Reference Sensitivity
§2.1.6 Signal Delay Spread Capability
§2.1.7 Adjacent Channel Rejection
§2.1.8 Co-Channel Rejection
§2.1.9 Spurious Response Rejection
§2.1.10 Intermodulation Rejection
§2.1.11 Signal Displacement Bandwidth
§2.1.17 Late Entry Un-squelch Delay
§2.1.18 Receiver Throughput Delay
§2.2.8 Unwanted Emissions: Adjacent Channel Power Ratio
§2.2.12 Transmitter Power and Encoder Attack Time
§2.2.14 Transmitter Throughput Delay
§2.2.15 Frequency Deviation for C4FM
§2.2.16 Modulation Fidelity

5.28 Hazardous Environment Intrinsically Safe Radios

5.28.1 The Proposer shall propose all portable radios that meet Factory Mutual (FM) standards for Intrinsically Safe (IS) operation in a hazardous or explosive environment. The Proposer shall detail how FM rating is achieved in the offered models, and fully explain if any variations or combinations in subscriber radio, battery pack and accessory offerings are required to meet standards for IS operation.

5.29 Portable Radio Multi-Chemistry Batteries

5.29.1 Owner expects to benefit from the latest battery chemistry and charging technology options for its radio subscriber units. Proposed battery models for portable subscriber units shall support operation for work shift durations of twelve (12) hours. Battery weight, size and reliability are considerations for first responder radios and therefore the proposer shall provide comparisons on power density, run-time and size for each proposed battery chemistry.

5.29.2 Note: Batteries utilizing Nickel-Cadmium (Ni-Cd) chemistry shall not be considered acceptable for First Responder radios and should not be proposed.

5.29.3 The Proposer shall detail available configurations for each proposed model or tier of portable radio offering, including:

5.29.3.1 Clam-shell designs for alkaline cells
5.29.3.2 Battery pack chemistry options
5.29.3.3 Cell power density (v/mAh)
5.29.3.4 12 VDC battery eliminator options for each proposed model or tier of portable radio offering.
5.30 Battery Chargers for Portable Radios

5.30.1 All battery chargers for portable radios should fully and completely recharge a portable battery in one hour. It is desirable that the charging adaptor permits portable radios to be operated in both receive and transmit while charging. The complete portable radio or the battery alone shall be inserted into the battery charger pocket to be charged. No other action shall be required.

5.30.2 Proposers shall define the charge times for each charger type being proposed, and their battery chargers ability to provide the following:

- 5.30.2.1 Single chargers shall accommodate one portable radio or battery at a time
- 5.30.2.2 Multi chargers shall accommodate four or more portable radios or batteries at one time. All chargers shall operate from nominal 120 VAC power
- 5.30.2.3 A 12 VDC battery charging option is also desired, especially one offering vehicular cigarette lighter adaptor operation
- 5.30.2.4 All chargers shall come complete with a power cube or power cord suitable for mating with a NEMA 5-15R or 5-20R grounded receptacle
- 5.30.2.5 Specialty Vehicles and Fire Apparatus shall have equivalent single and gang chargers installed as replacements, to include multi-chemistry chargers

5.30.3 Both single and multi-unit (gang) charger options shall be detailed. At a minimum, charger units shall support the following features:

- 5.30.3.1 Automatic cell reconditioning
- 5.30.3.2 Multi-chemistry support of NiCad, NiMH, Li-Ion and Li-Polymer battery cells
- 5.30.3.3 Single and Multi-unit models
- 5.30.3.4 Visible or audible indications of battery charge state, life expectancy or failure
- 5.30.3.5 Measurement of battery capacity for Radio Shop personnel to triage battery stock for disposition and replacement.

5.31 Portable Radio Vehicular Adapter

5.31.1 A subset of PSERN radio subscribers will benefit from the flexibility of a convertible adapter for enhanced vehicular use. The Proposer shall detail optional accessory devices or kits allowing the use of their portable radio in a vehicle and emulating basic or limited mobile transceiver functionality. The vehicular adaptor shall, at a minimum provide the following:

- 5.31.1.1 Insertion cradle adapter with positive securing of portable radio
- 5.31.1.2 Power supply with battery charging circuitry operating from 12 VDC
- 5.31.1.3 Audio amplification circuitry with provisions for externally mounted speaker
- 5.31.1.4 RF amplification to provide typical mobile output power levels
5.31.1.5 Provision for use of handheld microphone (adapter mounted and/or radio mounted)

5.31.1.6 Industry-standard RF connector for use with external antenna and/or RF power amplifier

5.31.1.7 Options allowing remote control, visual status or display shall be detailed

5.31.1.8 Capability to secure radio within cradle adaptor with keyed lock is desirable, but not mandatory

5.32 Mobile Radio Equipment General Requirements

5.32.1 The Proposer shall provide details regarding multiple tiers of equipment offered. All model tiers proposed shall conform to TIA-102 Class A (for P25 operation) and TIA-603 (for analog operation) radio specifications and support both 700 MHz and 800 MHz operation. Proposers shall also provide a list showing other manufacturer’s subscriber units (i.e. make, model) that have been tested on the system and approved for use.

5.33 First Responder Mobile Radio Requirements

5.33.1 The First Responder radio subscriber model is expected to be subjected to the most rigorous duty environment and issued to Fire, Rescue and Law Enforcement first responders. It is considered a “high-tier” radio from a feature set standpoint and is expected to offer the user the highest level of level of functional capability.

5.33.2 The First Responder shall offer analog and digital operation, multi-channel or talk-group selector switch, transmit LED indicator, low battery warning, emergency button, industry standard data interface.

5.33.3 For display and user interface capabilities this model tier shall offer a full or enhanced multi-line display screen of a minimum of two (2) rows of twelve (12) characters each, full keypad, programmable function keys, user-accessible menus, and provide for a minimum of 512 channels/talk groups. It shall support multiple encryption key capability.

5.34 General Government Mobile Radio Requirements

5.34.1 The General Government radio subscriber model is expected to be used in a less demanding operational environment than the First Responder role and will typically be issued to government administrative agencies, animal control, public works and utilities. It is considered a “middle-tier” radio from a feature set standpoint and is expected to offer the user the functional capabilities commensurate with its intended role.

5.34.2 The General Government radio subscriber model shall offer analog and digital operation, multi-channel or talk-group selector switch, transmit LED indicator, low battery warning, emergency button, industry standard data interface.

5.34.3 For display and user interface capabilities this model tier shall offer a limited display screen of a minimum of ten (10) characters, basic/limited keypad programmable function keys, user-accessible menus, and provide for a minimum of 256 channels/talk groups.
5.35 Miscellaneous Agency Mobile Radio Requirements

5.35.1 This radio subscriber model will be issued to qualified agencies having system access but with a very limited operational environment. It will typically be issued to municipal government agencies, school districts and for administrative, volunteer or other events. It is considered a “lower-tier” radio from a feature set standpoint and is expected to offer the user basic functional capabilities.

5.35.2 The Miscellaneous Agency radio subscriber model shall offer basic standard features such as analog and digital operation, multi-channel/talk group selector switch, transmit LED indicator, low battery warning, emergency button, industry standard data interface, and provide a minimum of 128 channels/talk groups.

5.36 Mobile Radio Accessories

5.36.1 For reference purposes, the current radio equipment issue for PSERN first responder agencies is listed below and includes the following:

5.36.1.1 Mobile Radio (Trunk or Dash mount unit that is field convertible from one to the other)

5.36.1.2 Multiple Control Head options (used by some fire and rescue apparatus)

5.36.1.3 Associated hardware to mount radio and remote control head

5.36.1.4 Audio interface suitable for connection to external PA

5.36.1.5 External speaker & mounting bracket

5.36.1.6 External microphone & microphone clip

5.36.1.7 Low profile dual-band (700/800 MHz) antenna with NMO cable and appropriate RF connector to be replaced during mobile installations

5.36.1.8 Cable kit with minimum required length of cable (power and control)

5.36.1.9 Fuses and associated hardware for power leads as required by manufacturer

5.36.2 The Proposer shall outline in detail the standard accessories provided with their mobile radio offering. This shall all available cable lengths (remote cable, DC power, remote speaker).
5.37 Mobile Radio Environmental Specification

5.37.1 The Proposer’s offered mobile radio shall meet or exceed the following Environmental Specification:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Parameter</th>
<th>Method</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIL-STD-810F</td>
<td>Low Pressure</td>
<td>500.5</td>
<td>ii</td>
</tr>
<tr>
<td></td>
<td>High Temperature</td>
<td>501.5</td>
<td>I-A1, II</td>
</tr>
<tr>
<td></td>
<td>Low Temperature</td>
<td>502.5</td>
<td>I-C3, II</td>
</tr>
<tr>
<td></td>
<td>Temperature Shock</td>
<td>503.5</td>
<td>I-C</td>
</tr>
<tr>
<td></td>
<td>Solar Radiation</td>
<td>505.5</td>
<td>I-A1</td>
</tr>
<tr>
<td></td>
<td>Rain</td>
<td>506.5</td>
<td>I, III</td>
</tr>
<tr>
<td></td>
<td>Humidity</td>
<td>507.5</td>
<td>II-Aggravated</td>
</tr>
<tr>
<td></td>
<td>Salt Fog</td>
<td>509.5</td>
<td>1 Proc</td>
</tr>
<tr>
<td></td>
<td>Blowing Dust</td>
<td>510.5</td>
<td>I, II</td>
</tr>
<tr>
<td></td>
<td>Vibration (min. integrity)</td>
<td>514.6</td>
<td>I-cat 24</td>
</tr>
<tr>
<td></td>
<td>Shock</td>
<td>516.6</td>
<td>I, V, VI</td>
</tr>
</tbody>
</table>

Table 5.37 Mobile Radio Environmental Specification
## Mobile Radio Transmitter Specification

The mobile radio transmitter performance shall meet or exceed the following specification:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MOBILE RADIO TRANSMITTER PERFORMANCE SPECIFICATION</strong></td>
<td></td>
</tr>
<tr>
<td>Frequency Range (MHz)</td>
<td>764-776, 794-806, 806-825, 851-869</td>
</tr>
<tr>
<td>Channel Spacing</td>
<td>25/12.5 kHz</td>
</tr>
<tr>
<td>RF Power Output</td>
<td>30 Watts minimum</td>
</tr>
<tr>
<td>Frequency Stability (-30 ~ +60°C)</td>
<td>±1.5 ppm</td>
</tr>
<tr>
<td>Modulation Deviation (kHz)</td>
<td>±2.5, ±4.0 (NPSPAC), or ±5.0</td>
</tr>
<tr>
<td>FM Hum and Noise (dB)</td>
<td>&gt;40 (non-NPSPAC), &gt;38 (NPSPAC), &gt;34 (12.5 kHz 700 MHz)</td>
</tr>
<tr>
<td>Audio Response (dB)</td>
<td>+1, -3 (EIA)</td>
</tr>
<tr>
<td>Spurious and Harmonics (dBm/dbc)</td>
<td>Meets FCC part 90; emission mask &quot;G&quot; and &quot;H&quot; for 700/800 MHz</td>
</tr>
<tr>
<td>Frequency Separation (MHz)</td>
<td>Full Bandwidth/Band split</td>
</tr>
<tr>
<td>Audio Distortion</td>
<td>&lt;2% at rated audio @1 kHz, 3 kHz deviation</td>
</tr>
<tr>
<td>P25 (C4FM) Modulation Fidel (%)</td>
<td>&lt;5</td>
</tr>
<tr>
<td>P25 Adjacent Channel Power (dbc)</td>
<td>&gt;67</td>
</tr>
</tbody>
</table>

Table 5.38 Mobile Radio Transmitter Specification
5.39 Mobile Radio Receiver Specification

5.39.1 The mobile radio receiver performance shall meet or exceed the following specification:

<table>
<thead>
<tr>
<th>MOBILE RADIO RECEIVER PERFORMANCE SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range (MHz)</td>
</tr>
<tr>
<td>Channel Spacing (kHz)</td>
</tr>
<tr>
<td>Sensitivity (12 dB SINAD), (uV/dBm)</td>
</tr>
<tr>
<td>P25 Reference Sensitivity (5% bit error rate) (uV/dBm)</td>
</tr>
<tr>
<td>Adjacent Channel Rejection @25 kHz (dB)</td>
</tr>
<tr>
<td>P25 Adjacent Channel Rejection @12.5 kHz</td>
</tr>
<tr>
<td>Selectivity (dB)</td>
</tr>
<tr>
<td>Intermodulation (dB) @ 12.5 kHz</td>
</tr>
<tr>
<td>Spurious Rejection (dB)</td>
</tr>
<tr>
<td>FM Hum and Noise</td>
</tr>
<tr>
<td>Frequency Stability (-30 ~ +60°C)</td>
</tr>
<tr>
<td>Frequency Separation (MHz)</td>
</tr>
<tr>
<td>Audio Output (W)</td>
</tr>
<tr>
<td>Audio Distortion</td>
</tr>
</tbody>
</table>

Table 5.39 Mobile Radio Receiver Specification
5.40 Multi-Band Radio General Requirements

5.40.1 The Proposer shall provide details regarding portable radio equipment offered in multi-band configuration. All model tiers proposed shall conform to TIA-102 Class A radio specifications and support both VHF (136 – 174 MHz) and 700MHz/800 MHz operation contiguously. UHF operation is not required for a multi-band subscriber offering by the Owner. Proposers shall also provide a list showing other manufacturer’s multi-band subscriber units (i.e. make, model) that have been tested on the system and approved for use. The proposed radio shall have Type Acceptance for FCC Part 22, Part 80 and Part 90 operation.

5.41 Hazardous Environment Intrinsically Safe Multi-Band Radios

5.41.1 The Proposer shall propose all portable radios that meet Factory Mutual (FM) standards for Intrinsically Safe (IS) operation in a hazardous or explosive environment. The Proposer shall detail how FM rating is achieved in the offered models, and fully explain if any variations or combinations in subscriber radio, battery pack and accessory offerings are required to meet standards for IS operation.
5.42 Multi-Band Portable Radio Environmental Specification

5.42.1 The proposed multi-band portable radio shall meet or exceed the following Environmental Specification:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Parameter</th>
<th>Method</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIL-STD-810F</td>
<td>Low Pressure</td>
<td>500.5</td>
<td>ii</td>
</tr>
<tr>
<td></td>
<td>High Temperature</td>
<td>501.5</td>
<td>I-A1, II-A2</td>
</tr>
<tr>
<td></td>
<td>Low Temperature</td>
<td>502.5</td>
<td>I-C3, II-C1</td>
</tr>
<tr>
<td></td>
<td>Temperature Shock</td>
<td>503.5</td>
<td>I-C</td>
</tr>
<tr>
<td></td>
<td>Solar Radiation</td>
<td>505.5</td>
<td>I-A1</td>
</tr>
<tr>
<td></td>
<td>Rain</td>
<td>506.5</td>
<td>I, III</td>
</tr>
<tr>
<td></td>
<td>Humidity</td>
<td>507.5</td>
<td>II-Aggravated</td>
</tr>
<tr>
<td></td>
<td>Salt Fog</td>
<td>509.5</td>
<td>1 Proc</td>
</tr>
<tr>
<td></td>
<td>Blowing Dust</td>
<td>510.5</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>Blowing Sand</td>
<td>510.5</td>
<td>II</td>
</tr>
<tr>
<td></td>
<td>Immersion</td>
<td>512.5</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>Vibration</td>
<td>514.6</td>
<td>I-24</td>
</tr>
<tr>
<td></td>
<td>Shock</td>
<td>516.6</td>
<td>I, V, VI</td>
</tr>
<tr>
<td></td>
<td>Shock (dropped)</td>
<td>516.6</td>
<td>IV</td>
</tr>
</tbody>
</table>

Table 5.42 Multi-Band Portable Radio Environmental Specification
5.43 Multi-Band Portable Radio Transmitter Specification

5.43.1 The proposed multi-band portable radio transmitter performance shall meet or exceed the following specification:

<table>
<thead>
<tr>
<th>MULTI-BAND PORTABLE RADIO TRANSMITTER PERFORMANCE SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range (MHz)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Channel Spacing (kHz)</td>
</tr>
<tr>
<td>RF Power Output</td>
</tr>
<tr>
<td>Frequency Stability (-30 ~ +60°C)</td>
</tr>
<tr>
<td>Modulation Deviation (kHz)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>FM Hum and Noise (dB)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Audio Response (dB)</td>
</tr>
<tr>
<td>Spurious and Harmonics (dBm/dBc)</td>
</tr>
<tr>
<td>Frequency Separation (MHz)</td>
</tr>
<tr>
<td>Audio Distortion</td>
</tr>
<tr>
<td>P25 (C4FM) Modulation Fidel (%)</td>
</tr>
<tr>
<td>P25 Adjacent Channel Power (dBc)</td>
</tr>
</tbody>
</table>

Table 5.43 Multi-Band Portable Radio Transmitter Specification
### 5.44 Multi-Band Portable Radio Receiver Specifications

5.44.1 The proposed multi-band portable radio receiver performance shall meet or exceed the following specification:

<table>
<thead>
<tr>
<th>Specification</th>
<th>VHF</th>
<th>700 MHz</th>
<th>800 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency Range (MHz)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Channel Spacing (kHz)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>700/800 MHz</td>
<td>12.5/25</td>
<td>30/25/12.5</td>
<td></td>
</tr>
<tr>
<td><strong>Analog Sensitivity @ 12 dB SINAD (dBm)</strong></td>
<td>700/800 MHz</td>
<td>VHF</td>
<td>-119</td>
</tr>
<tr>
<td><strong>P25 reference Sensitivity @ 5% BE (dBm)</strong></td>
<td>700/800 MHz</td>
<td>VHF</td>
<td>-119</td>
</tr>
<tr>
<td><strong>Adjacent Channel Rejection @ 25 kHz (dB)</strong></td>
<td></td>
<td></td>
<td>&gt;75</td>
</tr>
<tr>
<td><strong>P25 Adjacent Channel Rejection @ 12.5 kHz</strong></td>
<td></td>
<td></td>
<td>&gt;60</td>
</tr>
<tr>
<td><strong>Selectivity (dB)</strong></td>
<td>VHF</td>
<td>700 MHz</td>
<td>800 MHz</td>
</tr>
<tr>
<td></td>
<td>&gt;90 (30 kHz)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>&gt;85 (25 kHz)</td>
<td>&gt;85</td>
<td>&gt;85</td>
</tr>
<tr>
<td></td>
<td>&gt;75 (12.5 kHz)</td>
<td>&gt;75</td>
<td>&gt;75</td>
</tr>
<tr>
<td><strong>Intermodulation (dB) @ 12.5 kHz</strong></td>
<td></td>
<td></td>
<td>&gt;78</td>
</tr>
<tr>
<td><strong>Spurious Rejection (dB)</strong></td>
<td>VHF</td>
<td>700 MHz</td>
<td>800 MHz</td>
</tr>
<tr>
<td></td>
<td>&gt;90</td>
<td>&gt;75</td>
<td>&gt;75</td>
</tr>
<tr>
<td><strong>FM Hum and Noise</strong></td>
<td>VHF</td>
<td>700 MHz</td>
<td>800 MHz</td>
</tr>
<tr>
<td></td>
<td>&gt;50 (25 kHz)</td>
<td>&gt;50</td>
<td>&gt;50</td>
</tr>
<tr>
<td></td>
<td>&gt;45 (12.5 kHz)</td>
<td>&gt;45</td>
<td>&gt;45</td>
</tr>
<tr>
<td><strong>Frequency Stability (-30 ~ +60°C)</strong></td>
<td></td>
<td></td>
<td>±1.0 ppm or better</td>
</tr>
<tr>
<td><strong>Frequency Separation (MHz)</strong></td>
<td></td>
<td></td>
<td>Full Bandwidth on each operational band</td>
</tr>
<tr>
<td><strong>Audio Output (W)</strong></td>
<td>1 or better</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Audio Distortion</strong></td>
<td></td>
<td>&lt;2% @ rated power</td>
<td></td>
</tr>
</tbody>
</table>

*Table 5.44 Multi-Band Portable Radio Receiver Specification*
5.45 Multi-Band Portable Radio Multi-Chemistry Batteries

5.45.1 Owner expects to benefit from the latest battery chemistry and charging technology options for its multi-band portable radio subscriber units. Proposed battery models for portable subscriber units shall support operation for work shift durations of twelve (12) hours. Battery weight, size and reliability are considerations for first responder radios and therefore the proposer shall provide comparisons on power density, run-time and size for each proposed battery chemistry.

5.45.2 Note: Batteries utilizing Nickel-Cadmium (Ni-Cd) chemistry shall not be proposed.

5.45.3 The Proposer shall detail available configurations, including clam-shell designs for alkaline cells, battery pack chemistry options, and cell power density (v/mAh) and 12VDC battery eliminator options for each proposed model or tier of portable radio offering.

5.46 Multi-Band Portable Radio Vehicular Adapter

5.46.1 A subset of PSERN radio subscribers will benefit from the flexibility of a convertible adapter for enhanced vehicular use. The Proposer shall detail optional accessory devices or kits allowing the use of their multi-band portable radio in a vehicle and emulating basic or limited mobile transceiver functionality. The vehicular adaptor shall, at a minimum provide the following:

5.46.1.1 Insertion cradle adapter with positive securing of portable radio
5.46.1.2 Power supply with battery charging circuitry operating from 12 VDC
5.46.1.3 Audio amplification circuitry with provisions for externally mounted speaker
5.46.1.4 RF amplification to provide typical mobile output power levels across multiple bands
5.46.1.5 Provision for use of handheld microphone (adapter mounted and/or radio mounted)
5.46.1.6 Industry-standard RF connector for use with external antenna and/or RF power amplifier
5.46.1.7 Options allowing remote control, visual status or display shall be detailed
5.46.1.8 Capability to secure radio within cradle adaptor with keyed lock is desirable, but not mandatory

5.47 Multi-Band Portable Radio Accessories

5.47.1 For reference purposes, the current portable radio equipment issued for PSERN first responder agencies is listed below and includes:

5.47.1.1 Antenna
5.47.1.2 Two (2) high-capacity batteries (providing for at least 12 hours of continuous operation based on a 6 second transmit, 6 second receive, 48 second standby cycle)
5.47.1.3 Standard speaker microphone (not the public safety microphone with integrated antenna)
5.47.1.4 Public Safety grade leather case with swivel and large belt loop
5.47.1.5 Home charger for battery
5.47.1.6 12 VDC vehicular charging option (ex. cigarette lighter adapter, mobile mount for charger)

5.47.2 The Proposer shall outline in detail the standard accessories provided with their multi-band portable radio offering.

5.48 Multi-Band Mobile Radio General Requirements
5.48.1 The Proposer shall provide details regarding mobile radio equipment offered in multi-band configuration. All model tiers proposed shall conform to TIA-102 Class A radio specifications and support both VHF (136 – 174 MHz) and 700MHz/800 MHz operation contiguously. Proposers shall also provide a list showing other manufacturer’s multi-band subscriber units (i.e. make, model) that have been tested on the system and approved for use. The proposed radio shall have Type Acceptance for FCC Part 22, Part 80 and Part 90 operation.

5.49 Multi-Band Radio Required Functionality
5.49.1 Radio subscriber equipment proposed for use on the PSERN shall support group, individual, dispatch, system-wide, network-wide and emergency calls on each band of operation. Equipment shall also meet or exceed Mil Spec 810D, E and F for low pressure, high temperature, low temperature, Shock, humidity, salt fog, and vibration.

5.49.2 In addition, the Proposer shall detail the following with regards to their proposed radio subscriber equipment:
5.49.2.1 Evidence of FCC Part 90 Type Acceptance
5.49.2.2 Conformance to TIA-102 Class A performance specifications
5.49.2.3 Compliance to Applicable MIL Spec 810 standards
5.49.2.4 Encryption modes supported
5.49.2.5 Supported P25 functionality
5.49.2.6 Standard and Optional User Accessories
5.49.2.7 GPS location and tracking capability via internal option or external interface
5.49.2.8 Support for immersion in water (IPX7) and dust and water ingress (IP54)
5.49.2.9 Support for Intrinsically Safe (IS) and Factory Mutual (FM) option
5.49.2.10 Support for low profile or high performance (dB gain) antenna options
5.49.2.11 Support for covert surveillance adaptors that support an earpiece and microphone/PTT
5.49.2.12 Support for standard or optional color LCD
5.49.2.13 Support for audio playback/voice announcement of operating modes via user- or pre-recorded sound files.
5.50 Required Performance Levels of Multi-Band Subscriber Units

5.50.1 Multi-Band Radio Subscriber units shall conform to Class A and tested in accordance with the following sections of ANSI/TIA-102.CAAA-A1, and shall meet or exceed all of the minimal performance recommendations (or Class B requirements where applicable) as specified in ANSI/TIA-102.CAAB-A.

5.50.1.1 §2.1.4 Reference Sensitivity
§2.1.5 Faded Reference Sensitivity
§2.1.6 Signal Delay Spread Capability
§2.1.7 Adjacent Channel Rejection
§2.1.8 Co-Channel Rejection
§2.1.9 Spurious Response Rejection
§2.1.10 Intermodulation Rejection
§2.1.11 Signal Displacement Bandwidth
§2.1.17 Late Entry Un-squelch Delay
§2.1.18 Receiver Throughput Delay
§2.2.8 Unwanted Emissions: Adjacent Channel Power Ratio
§2.2.12 Transmitter Power and Encoder Attack Time
§2.2.14 Transmitter Throughput Delay
§2.2.15 Frequency Deviation for C4FM
§2.2.16 Modulation Fidelity

5.51 Multi-Band Mobile Radio Environmental Specification

5.51.1 The multi-band mobile radio shall meet or exceed the following Environmental Specification:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Parameter</th>
<th>Met</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIL-STD-8</td>
<td>Low Pressure</td>
<td>500.5</td>
<td>ii</td>
</tr>
<tr>
<td></td>
<td>High Temperature</td>
<td>501</td>
<td>I-A1, II</td>
</tr>
<tr>
<td></td>
<td>Low Temperature</td>
<td>502</td>
<td>I-C3, II</td>
</tr>
<tr>
<td></td>
<td>Temperature Shock</td>
<td>503</td>
<td>I-C</td>
</tr>
<tr>
<td></td>
<td>Solar Radiation</td>
<td>505</td>
<td>I-A1</td>
</tr>
<tr>
<td></td>
<td>Rain</td>
<td>506</td>
<td>I, III</td>
</tr>
<tr>
<td></td>
<td>Humidity</td>
<td>507</td>
<td>II-Aggrav</td>
</tr>
<tr>
<td></td>
<td>Salt Fog</td>
<td>509</td>
<td>1 Proc</td>
</tr>
<tr>
<td></td>
<td>Blowing Dust</td>
<td>510</td>
<td>I, II</td>
</tr>
<tr>
<td></td>
<td>Vibration (min. integ)</td>
<td>514</td>
<td>I-cat 24</td>
</tr>
<tr>
<td></td>
<td>Shock</td>
<td>516</td>
<td>I, V, VI</td>
</tr>
</tbody>
</table>

Table 5.51 Multi-Band Mobile Radio Environmental Specification
### 5.52 Multi-Band Mobile Radio Transmitter Specification

5.52.1 The multi-band mobile radio transmitter performance shall meet or exceed the following specifications:

#### VHF & 700/800 MHz Multiband Mobile Radio Transmitter Performance Specification

<table>
<thead>
<tr>
<th>Specification</th>
<th>VHF</th>
<th>700 MHz</th>
<th>800 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range (MHz)</td>
<td>136–174, 764-776, 794-806, 806-824, 851-870</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel Spacing (kHz)</td>
<td>25/12.5 (700/800), 30/25/12.5 (VHF)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RF Power Output</td>
<td>30 Watts min. (700/800), 40 Watts min. (VHF)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency Stability (-30 ~ +60°C)</td>
<td>±1.0 ppm or better</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modulation Deviation (kHz)</td>
<td>±2.5, ±4.0 (NPSPAC), or ±5.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FM Hum and Noise (dB)</td>
<td>700/800 MHz, VHF, &gt;50 (25 kHz), &gt;53 (25 kHz), &gt;48 (12.5 kHz), &gt;52 (12.5 kHz)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audio Response (dB)</td>
<td>+1, -3 (EIA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spurious and Harmonics (dBm/dBc)</td>
<td>Meets FCC part 90; emission mask &quot;G&quot; and &quot;H&quot; for 700/800 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency Separation (MHz)</td>
<td>Full Bandwidth/Band split per band of operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audio Distortion</td>
<td>&lt;2% at rated audio @1 kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P25 (C4FM) Modulation Fidelity (%)</td>
<td>&lt;2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P25 Adjacent Channel Power (dBc)</td>
<td>&gt;67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.52 Multi-Band Mobile Radio Transmitter Specification
### Multi-Band Mobile Radio Receiver Specification

5.53.1 The proposed multi-band mobile radio receiver performance shall meet or exceed the following specifications:

<table>
<thead>
<tr>
<th>VHF &amp; 700/800 MHz MULTIBAND MOBILE RADIO RECEIVER PERFORMANCE SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency Range (MHz)</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Channel Spacing (kHz)</strong></td>
</tr>
<tr>
<td><strong>Analog Sensitivity @ 12 dB SINAD (dBm)</strong></td>
</tr>
<tr>
<td><strong>P25 reference Sensitivity @ 5% BE (dBm)</strong></td>
</tr>
<tr>
<td><strong>Adjacent Channel Rejection @25 kHz (dB)</strong></td>
</tr>
<tr>
<td><strong>P25 Adjacent Channel Rejection @12.5 kHz</strong></td>
</tr>
<tr>
<td><strong>Selectivity (dB)</strong></td>
</tr>
<tr>
<td><strong>Intermodulation (dB) @ 12.5 kHz</strong></td>
</tr>
<tr>
<td><strong>Spurious Rejection (dB)</strong></td>
</tr>
<tr>
<td><strong>FM Hum and Noise</strong></td>
</tr>
<tr>
<td><strong>Frequency Stability (-30 ~ +60°C)</strong></td>
</tr>
<tr>
<td><strong>Frequency Separation (MHz)</strong></td>
</tr>
<tr>
<td><strong>Audio Output (W)</strong></td>
</tr>
<tr>
<td><strong>Audio Distortion</strong></td>
</tr>
</tbody>
</table>

Table 5.53 Multi-Band Mobile Radio Receiver Specification

## Multi-Band Mobile Radio Accessories

5.54.1 For reference purposes, the current radio equipment issue for PSERN first responder agencies is listed below and includes the following:

5.54.1.1 Mobile Radio (Trunk or Dash mount unit that is field convertible from one to the other)
5.54.1.2 Dual Control Head options (used by some fire and rescue apparatus)
5.54.1.3 Associated hardware to mount radio and remote control head
5.54.1.4 Audio interface suitable for connection to external PA
5.54.1.5 External speaker & mounting bracket
5.54.1.6 External microphone & microphone clip
5.54.1.7 Low profile tri-band antenna (VHF/700/700 MHz) antenna with NMO cable and appropriate RF connector to be replaced during mobile installations
5.54.1.8 Cable kit with minimum required length of cable (power and control)
5.54.1.9 Fuses and associated hardware for power leads as required by manufacturer

5.54.2 The Proposer shall outline in detail the standard accessories provided with their multi-band mobile radio offering.

5.55 Special Mission or Application Portable Radios

5.55.1 Extra Heavy Duty Portable Radios

5.55.1.1 Proposers offering physically hardened or “ruggedized” versions of their standard radio subscriber models shall detail the available models, and manufacturing or enclosure methods of providing this additional level of robustness. This includes modified form factor enclosures, engineered materials, break-resistant or impact-resistant external knobs and controls, extra loud audio capabilities or other factors for use in extreme conditions.

5.55.1.2 Proposers shall outline any additional costs associated with hardened product platforms.

5.55.2 Marine Environment Portable Radios

5.55.2.1 First Responder agencies on the PSERN perform marine and waterfront operations in both fresh and saltwater environments. These include operations on lakes, rivers and other waters within King County, including fire response, regular law enforcement patrol, emergency response, search and rescue, and boater safety education. Portable radios in this use are exposed to direct sea spray and immersion. The Proposer is to disclose any product offering extreme environment models that would be beneficial to the marine mission and afford extra protection and more reliable operation in such an environment.

5.55.2.2 The Proposer shall provide details on model variants or suitable solution(s) for a marine installation to include recommend marine-grade whip antennas suitable for installation in a high-vibration, corrosive saltwater environment.

5.55.2.3 Proposers are to note that the requirement for 700 MHz/800 MHz P25 Phase II TDMA capability shall not be exempted due to marine use.
5.56 Special Mission or Application Mobile Radios

5.56.1 Dual Control Head Radio

5.56.1.1 Various Owner first responder agencies operate specialty vehicles which utilize dual-control heads to operate a mobile radio. The most prevalent configuration is installed in ambulance, rescue and fire apparatus. These have the radio body with a control head, external speaker installed in the cab, and a second control head and external speaker installed at other crew positions. These vehicles require longer than normal control cables, and will take longer to install than the normal mobile radio installation.

5.56.1.2 The Owner requires the offered mobile radio (in a remote mount configuration) to support a minimum of two (2) remote heads with four (4) head support desirable.

5.56.1.3 Proposers shall indicate availability of dual control head radios and maximum quantity of heads supported.

5.56.2 Motorcycle Mobile Radio Variant

5.56.2.1 Motorcycle units for law enforcement patrol are radio subscribers on the PSEN system by various agencies. The Proposer shall disclose if they offer a mobile radio variant that is designed for use in motorcycle environment, where direct exposure to elements and UV radiation as well as a higher than normal vibration level is encountered. The motorcycle radio proposed should offer a weather-tight enclosure for mounting the mobile transceiver on current law enforcement motorcycle platforms.

5.56.2.2 The motorcycle radio shall support both 700MHz/800 MHz P25 Phase II TDMA operation, shall provide a remote head configuration for handlebar mounting, a weather resistant microphone and external speaker. An optional audio interface connection for use with a helmet integrated intercom system with handlebar/steering mounted PTT activation is desired. A reduced output power level may be required to control occupational RF exposure.

5.56.3 Extra Heavy Duty Mobile Radios

5.56.3.1 Proposers offering physically hardened or “ruggedized” versions of their standard radio subscriber models shall detail the available models, and manufacturing or enclosure methods of providing this additional level of robustness. This includes modified form factor enclosures, engineered materials, break-resistant or impact-resistant external knobs and controls, extra loud audio capabilities or other factors for use in extreme conditions.

5.56.3.2 Proposers shall outline any additional costs associated with hardened product platforms.

5.56.4 Marine Environment Mobile Radios

5.56.4.1 First Responder agencies on the PSERN perform marine and waterfront operations in both fresh and saltwater environments. These include operations on lakes, rivers and other waters within King County, including fire response, regular law enforcement patrol,
emergency response, search and rescue, and boater safety education. Mobile radios in this use are exposed to indirect sea spray and immersion. The Proposer is to disclose any product offering extreme environment options that would be beneficial to the marine mission and afford extra protection and more reliable operation in such an environment.

5.56.4.2 There is a requirement for a suitable mobile radio subscriber unit to be fitted within each marine platform and integrated into the interior communications system (ICS) for full PTT operation with headset interface.

5.56.4.3 The Proposer shall provide details on model variants or suitable solution(s) for a marine installation to include recommend marine-grade whip antennas suitable for installation in a high-vibration, corrosive saltwater environment. Additional pricing associated with higher specification rating options and accessories shall be provided.

5.56.4.4 Proposers are to note that the requirement for 700 MHz/800 MHz P25 Phase II TDMA capability shall not be exempted due to an marine installation.

5.56.5 Aircraft Radios

5.56.5.1 The King County Sheriff’s Air Support Unit is the only full-time rotary-wing law enforcement aviation unit in Washington State. It operates four helicopters in support of its activities. These assets are used for law enforcement and search and rescue (SAR) operational support and fulfill a critical first responder role.

5.56.5.2 Additionally, Airlift Northwest provides critical medical evacuation services, responding to incidents throughout King, Pierce and Snohomish Counties. These aircraft are also expected to need to be fitted with upgraded radios as a part of the PSERN deployment.

5.56.5.3 There is a requirement for a suitable mobile radio subscriber unit to be fitted within each airborne platform and integrated into the interior communications system (ICS) for full PTT operation with headset interface.

5.56.5.4 The Proposer shall provide details on model variants or suitable solution(s) for an airborne installation. Proposed P25 Radio Subscriber equipment receiving FAA TSO (Technical Standards Orders) authorization is preferred but not required. FCC requirements for Part 90 radios used aboard aircraft shall also be met by the proposed products. All Class A radio performance requirements should be met by any proposed radio.

5.56.5.5 While the primary requirement is for a 700/800 MHz radio, radios that provide a multiband capability may also be proposed.

5.56.5.6 Proposers are to note that the requirement for 700 MHz/800 MHz P25 Phase II TDMA capability shall not be exempted due to an airborne installation.
5.57  **Fire/EMS Headset/Intercom System Integration**

5.57.1  Fire/EMS apparatus installations incorporate crew intercom systems from which both internal (squad) communications as well as radio system (PTT) communications can be performed. The current intercom systems in use are specifically manufactured by:

5.57.1.1  Sigtronics
5.57.1.2  David Clark
5.57.1.3  Firecom

5.57.2  The Proposer shall disclose the suitability of their offered mobile transceivers for incorporation into the integrated crew audio (intercom) system used in mobile and airborne fire apparatus and any optional interface kits that may be required to support this capability.

5.57.3  The successful Proposer shall be responsible for the procurement, installation/integration and demonstration of proper radio-intercom operation as part of system commissioning.

5.58  **Radio Control Station General Requirements**

5.58.1  Some PSERN subscribers utilize mobile control stations for their respective applications. The Proposer’s response shall include the replacement of these with 700/800 MHz, P25 Phase II (TDMA) equivalent units. The control station solution encompasses desk-top control stations in small dispatch offices, where higher duty cycles will be required, to small control stations, with infrequent usage, located at rural facilities.

5.59  **Radio Control Station Required Functionality**

5.59.1  Proposers should propose mobile control station solutions based on the following required functional requirements:

5.59.1.1  Provide all of the functionality of the full featured, high tier mobile radio
5.59.1.2  Duty cycle of 25% transmit/75% receive for Full Base Station Console Configuration
5.59.1.3  Normal mobile duty cycle for Base in a Tray Configuration
5.59.1.4  Durable desktop microphone
5.59.1.5  Encryption capabilities identical to the standard high tier encrypted mobile

5.59.2  Proposers shall also price an integrated base station product that includes a mobile radio or mobile radio equivalent product in a fully engineered housing. These products are sometimes described as a base station console or control station console. Characteristics of this configuration include additional connectivity to audio accessories, tone/digital remote controls, a local clock, and improved transmitter duty cycles. The ability to provide 12 VDC back-up power and to charge a connected battery is required.

5.59.3  The control station console shall support the use of Plantronics dual plug, 6-conductor interface or equivalent at each control station radio through a jack box that allows an operator to plug-in and monitor calls with PTT functionality. The
provided interface shall also include the ability to provide for PTT control by single or dual foot pedal.

5.60 No Requirement for Multiband Radio Control Station Configurations

5.60.1 At the time of RFP issuance, it is not expected that there is a requirement for a control station configuration that includes VHF. Radios proposed shall be limited to 700/800 MHz operation only.

5.61 IP Networked Desktop Remote Dispatch Solutions for Control Station

5.61.1 A subset of PSERN users utilize desktop remote control units in office and other radio control station dispatching applications for convenience of communications. Desktop-style remotes that can locally or remotely operate a control station via an Ethernet (IP) connection is required. The Proposer shall detail recommended products that can provide this functionality as part of their proposal and the functional capabilities provided. The minimum required functionality for a desktop-style remote controller is as follows:

5.61.1.1 Replicates the functionality of the connected radio, including front panel functionality

5.61.1.2 Allows for interface of a variety of audio accessories (desk microphone, PTT footswitch, external speaker, wired or wireless headsets)

5.61.1.3 LCD indication of selected talk group or channel of operation, preferably replication of connected/attached transceiver's display

5.61.1.4 Display of received PTT ID while in an active call

5.61.1.5 Capability of parallel operation of multiple desktop units via single adapter

5.61.1.6 Front panel selection and calling of pre-defined groups or users

5.61.1.7 Audio mute button

5.61.1.8 Wall or desktop mounting

5.61.1.9 Provide an option for 12 VDC power

5.62 Radio Control Station Base Antenna System Requirements

5.62.1 All Proposals shall, as a cost option, include in the Proposal the cost of providing 75’ of Times Microwave LMR400 coaxial cable (or approved equivalent), antenna mount, and any required small diameter jumpers, as well as surge protection, connectors, clamps, clips and grounding kits, etc., in the proposed control station cost.

5.63 Vehicular Repeaters

5.63.1 The PSERN extends across a diverse regional topography that includes urban skyscrapers and shadowed tide flats to deep valleys and mountain passes. Despite the desire for significantly improved area radio coverage, first responders may lose talk-in ability when entering a structure or difficult to cover natural areas when in portable operation. As 97% area coverage reliability may not exist across the entire County, particularly in mountain passes, a convenient range extension solution is desired. The use of this optional range extension technology will only be used by a subset of PSERN first responders such as fire and law enforcement incident commanders, mobile command centers and rural brushfire responders.
5.63.2 A suitable technology to address this problem are vehicular repeaters or “range extenders” that allow dismounted responder's portable radios to utilize a nearby vehicle's mobile radio (or embedded repeater) to extend communications range on a selected trunked talk group. Vehicular systems that provide a conventional channel pair to trunked talk group 'translation' are to be considered.

5.63.3 The desire is to maintain the channel efficiency provide by P25 Phase II TDMA operation. Those solutions that allow the mobile radio to continue to operate as P25 Phase II TDMA mobile radios are strongly desired (when the talkgroup selected by the mobile radio is a TDMA talkgroup).

5.63.4 The Proposer shall recommend and detail suitable range extension products and also verify that the offered solution has been tested, implemented and compatible with their radio system operation with no loss of emergency call function and radio PTT ID function.

5.63.5 Acceptable vehicular repeater / range extension functionality includes, but is not limited to the following:

5.63.5.1 On-scene conventional simplex to 700/800 MHz trunked operation
5.63.5.2 On scene conventional half-duplex to 700/800 MHz trunked operation
5.63.5.3 On-scene conventional half-duplex with local repeated mode to 700/800 MHz trunked operation

5.63.6 Due to the primary requirement of 700/800 MHz operation the portable on-scene to vehicular radio link shall utilize channels in the 700 MHz or 800 MHz band. Proposers are invited to also detail support for cross-band (VHF to 700/800 MHz) configured solutions.

5.63.7 Maintaining digital operation over the vehicular repeater to portable link, with P25 signaling, is desired. Proposers should clarify their ability for vehicular repeaters to provide encrypted digital operation for those talkgroups on the connected mobile radios that are also digital capable.

5.63.8 If operation of the vehicular repeater as a local duplex repeater is possible, the features and capabilities associated with this mode of operation shall be specified in the Proposal.

5.63.9 This optional vehicular repeater capability is not a requirement and shall be offered as a priced option only.

5.64 Vehicular Repeater General Requirements

5.64.1 The vehicular repeater shall be easily installed and activated from within typical first responder mobile platforms.

5.64.2 A general description of desired features of the vehicular repeater is outlined below:

5.64.2.1 Easy and intuitive operation by first responders with minimal training/familiarity
5.64.2.2 Vehicular repeat initiation via manual or automatic/intelligent activation
5.64.2.3 Integrated vehicular repeater control with a vehicular battery charger
5.64.2.4 Operational status including power, transmit and receive condition verifiable by easily observed visible indicators (LEDs, lamps, etc.)
5.64.2.5 Interface support for the proposed models of first responder grade mobile radios

5.65 Vehicular Repeater Performance Requirements

5.65.1 Full 700 MHz / 800 MHz operation
5.65.2 Cross-band (VHF to 800 MHz or 700 MHz to 800 MHz) capability as an optional configuration
5.65.3 Programmable channels in 6.25, 12.5, 20 or 25 kHz steps
5.65.4 Support for mixed mode (analog and P25 Phase I FDMA) operation
5.65.5 Transparent to DES-OFB or AES-256 digital encryption formats
5.65.6 Programmable RF power output of 0.5 – 5 watts
5.65.7 Radio access validation on a per-channel basis via P25 NAC, CTCSS or DCS
5.65.8 Provision for internally-mounted mobile-style duplexer or RF filtering to prevent in-band receiver desensitization
5.66 \textbf{Vehicular Repeater Specification}

5.66.1 The proposed multi-band mobile radio receiver performance shall meet or exceed the following specification:

<table>
<thead>
<tr>
<th><strong>Transmitter</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency Range</strong></td>
<td>764 – 776 MHz 851 – 870 MHz</td>
</tr>
<tr>
<td><strong>Bandwidth</strong></td>
<td>Full contiguous band</td>
</tr>
<tr>
<td><strong>Frequency Stability</strong></td>
<td>$\leq 1.5$ ppm</td>
</tr>
<tr>
<td><strong>Modulation Deviation</strong></td>
<td>$\pm 2.5, \pm 4.0, \pm 5.0$ kHz</td>
</tr>
<tr>
<td><strong>Spurious and Harmonic Attenuation</strong></td>
<td>60 dB</td>
</tr>
<tr>
<td><strong>Digital Modulation Fidelity</strong></td>
<td>$&lt; 5%$</td>
</tr>
<tr>
<td><strong>FM Hum &amp; Noise</strong></td>
<td>35 dB @12.5 kHz, 40 dB @ 25.0 kHz</td>
</tr>
<tr>
<td><strong>Analog Audio Response</strong></td>
<td>+1, -3 dB</td>
</tr>
<tr>
<td><strong>Analog Audio Distortion</strong></td>
<td>$&lt; 2%$ @ 1 kHz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Receiver</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency Range</strong></td>
<td>794 – 806 MHz, 806 – 825 MHz</td>
</tr>
</tbody>
</table>
| **Selectivity** | 60 dB @ 12.5kHz  
75 dB @ 25.0 kHz |
| **Digital Adjacent Channel Rejection** | 60 dB @ 12.5 kHz |
| **Analog Sensitivity** | -115 dBm |
| **Digital Sensitivity 5\% BER** | -115 dBm |
| **Channel Bandwidth** | 12.5 kHz, 20 kHz, 25 kHz |
| **Frequency Stability** | $\leq 1.5$ ppm |
| **Intermodulation Rejection** | 75 dBm |
| **Spurious and Image Rejection** | 100 dB |
| **Analog Audio Response** | +1, -3 dB |
| **Analog Audio Distortion** | 5\% @ 1 kHz |
| **FM Hum & Noise** | 45 dB @ 12.5 kHz, 50 dB @ 25 kHz |

\textbf{Table 5.66 Vehicular Repeater Specification}
5.67 Portable Tactical Repeaters

5.67.1 Due to the diverse territory and large population of the King County region, first responders often encounter events where incident management via on-scene communications is preferable to trunked system access or use of dedicated conventional channels for regional interoperability. Examples include natural disasters, special emergency response teams, and special events.

5.67.2 The Owner has licensed and available conventional 800 MHz channel pairs for tactical use, in addition to national and regional 700 MHz and 800 MHz interoperability pairs. The Owner desires to procure a cache of ruggedized and transportable conventional repeaters for on-scene communications. They may be integrated into mobile command center, command vehicles, or else transported to the scene and issued as needed.

5.68 Portable Tactical Repeater General Requirements

5.68.1 The tactical repeater shall be easily programmed and rapidly deployable to incident scenes. Due to operating conditions ranging from seashore to high-altitude year-round snow elevations and heavy annual rainfall, there tactical repeater needs environmental hardening and rugged design.

5.68.2 A general description of desired features of the transportable repeater is outlined below:

5.68.2.1 Single-person lift transportable with a weight of less than 60 lbs.

5.68.2.2 Ruggedized enclosure with O-ring seal or equivalent environmental protection in storage and transport configuration

5.68.2.3 Closed lid or closed case operation for maximum protection

5.68.2.4 Case-mounted NMO (or other industry standard) RF connector for quick install of standard or gain-type mobile antennas

5.68.2.5 Dual-band (700/800 MHz) or Tri-band (V/700/800 MHz) antenna as appropriate

5.68.2.6 Soft grip handle for comfortable carry

5.68.2.7 Enclosure shall incorporate wheels and extendable tow handle for transport on hard surfaces

5.68.2.8 Easy and intuitive field set-up and operation by first responders with minimal training/familiarity

5.68.2.9 Provision for direct attachment and stowage of mobile antenna

5.68.2.10 Cross-patch capability to link multiple tactical repeaters together for cross-band or other bridging applications

5.69 Portable Tactical Repeater Performance Requirements

5.69.1 Full 700 MHz / 800 MHz operation

5.69.2 Programmable channels in 6.25, 12.5, 20 or 25 kHz steps

5.69.3 Support for mixed mode (analog and P25 Phase I FDMA) operation

5.69.4 Transparent to DES-OFB or AES-256 digital encryption formats

5.69.5 P25 digital operation conforms to TIA Class “A”
5.69.6 Minimum of eight (8) selectable channels
5.69.7 Minimum programmable RF power output of 15 watts. Low power operation down to 1 watt is also a desirable option
5.69.8 Programmable on a per channel basis for simplex, half-duplex, and full-duplex (repeated) operation
5.69.9 Radio access validation on a per-channel basis via P25 NAC, CTCSS or DCS
5.69.10 Provision for internally-mounted mobile-style duplexer
5.69.11 Powered by 12 VDC input, with provision for internal AC power supply for 120 VAC operation
5.69.12 Provision for internally mounted rechargeable batteries
5.69.13 Provision for single or multiple (paralleled) external back-up battery packs with simple DC power interconnection cables
5.69.14 Optional support for P25 DFSI (Digital Fixed Station Interface) for remote IP tactical dispatch console operability
5.69.15 Receive standby power consumption of less than 500 mA
5.69.16 Local integrated speaker for monitoring repeater traffic
5.69.17 Local microphone for direct transmit control
5.69.18 Optional wire-line interface control supporting TIA-102BAHA
## 5.70 Portable Tactical Repeater Specification

5.70.1 The proposed multi-band mobile radio receiver performance shall meet or exceed the following specification:

<table>
<thead>
<tr>
<th><strong>Transmitter</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>762 – 776 MHz 851 – 870 MHz</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>Full contiguous band</td>
</tr>
<tr>
<td>Frequency Stability</td>
<td>≤ 1.0 ppm</td>
</tr>
<tr>
<td>Modulation Deviation</td>
<td>± 2.5, ± 4.0, ±5.0 kHz</td>
</tr>
<tr>
<td>Spurious and Harmonic Attenuation</td>
<td>60 dB</td>
</tr>
<tr>
<td>Audio sensitivity</td>
<td>-35 dB to 0 dBm, variable</td>
</tr>
<tr>
<td>Digital Modulation Fidelity</td>
<td>&lt; 5%</td>
</tr>
<tr>
<td>FM Hum &amp; Noise</td>
<td>45 dB @ 12.5 kHz, 50 dB @ 25.0 kHz</td>
</tr>
<tr>
<td>Analog Audio Response</td>
<td>+1, -3 dB</td>
</tr>
<tr>
<td>Analog Audio Distortion</td>
<td>&lt; 2% @ 1 kHz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Receiver</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>792 – 798 MHz, 806 – 825 MHz</td>
</tr>
<tr>
<td>Analog Adjacent Channel Rejection</td>
<td>80 dB @ 12.5 kHz 85 dB @ 20.0 kHz 90 dB @ 25.0 kHz</td>
</tr>
<tr>
<td>Digital Adjacent Channel Rejection</td>
<td>60 dB @ 12.5 kHz</td>
</tr>
<tr>
<td>Analog Sensitivity</td>
<td>-118 dBm</td>
</tr>
<tr>
<td>Digital Sensitivity 5% BER</td>
<td>-118 dBm</td>
</tr>
<tr>
<td>Channel Bandwidth</td>
<td>12.5 kHz, 20 kHz, 25 kHz</td>
</tr>
<tr>
<td>Frequency Stability</td>
<td>≤ 1.0 ppm</td>
</tr>
<tr>
<td>Intermodulation Rejection</td>
<td>85 dBm</td>
</tr>
<tr>
<td>Spurious and Image Rejection</td>
<td>100 dB</td>
</tr>
<tr>
<td>Analog Audio Response</td>
<td>+1, -3 dB</td>
</tr>
<tr>
<td>Analog Audio Distortion</td>
<td>5% @ 1 kHz</td>
</tr>
<tr>
<td>FM Hum &amp; Noise</td>
<td>45 dB @ 12.5 kHz, 50 dB @ 25 kHz</td>
</tr>
</tbody>
</table>

Table 5.70 Portable Tactical Repeater Specification
5.71 LMR Subscriber Statement of Work

5.71.1 The Proposer shall be responsible for providing a complete and fully functional fleet of P25 Phase II (TDMA) radio subscribers, ready for use on the proposed PSERN, as follows:

5.71.1.1 700/800 MHz P25 Phase II (TDMA) portable radios
5.71.1.2 700/800 MHz P25 Phase II (TDMA) mobile radios
5.71.1.3 700/800 MHz P25 Phase II (TDMA) radio control stations
5.71.1.4 700/800 MHz P25 Phase II (TDMA) ruggedized radios
5.71.1.5 700/800 MHz P25 Phase II (TDMA) aviation radios
5.71.1.6 700/800 MHz P25 Phase II (TDMA) marine environment radios
5.71.1.7 700/800 MHz P25 Phase II (TDMA) intrinsically safe (IS) radios
5.71.1.8 Multi-Band (V/700/800 MHz) P25 Phase II (TDMA) portable radios
5.71.1.9 Multi-Band (V/700/800 MHz) P25 Phase II (TDMA) mobile radios

5.71.2 The Proposer shall be responsible for providing the following project components and services:

5.71.2.1 Project Management
5.71.2.2 Radio preparation for use (removing radio subscriber unit from all factory shipping containers, packaging)
5.71.2.3 Radio assembly (antenna, battery pack, belt clip, cables, etc.)
5.71.2.4 Initial charge on all batteries
5.71.2.5 Software installation and programming
5.71.2.6 Firmware installation and configuration
5.71.2.7 Initial radio subscriber template creation
5.71.2.8 Initial programming of all radio subscriber units
5.71.2.9 Validation of subscriber conformance and Auto-Test and Auto-Tune of all subscribers before issue
5.71.2.10 Train the Trainer Training (operation)
5.71.2.11 Technical Staff Training (programming, optimization, testing)
5.71.2.12 Migration and transition plan and execution
5.71.2.13 Warranty and Post Warranty Support Services
5.71.2.14 Mobile Radio Installation (including power leads, control cables, remote heads, antennas, coaxial cables and grounding)
5.71.2.15 Control Station installation (including AC/DC power connection, interface cables, antennas, coaxial cables and grounding)
5.71.2.16 Barcode scanning for entry into inventory management system
5.72 Project Phases

5.72.1 Proposers shall follow an implementation approach that includes the following key phases:

5.72.1.1 Project Initiation through Notice To Proceed (NTP) and Kickoff Meeting
5.72.1.2 Final Design Review and subscriber unit count determination conducted post contract
5.72.1.3 Order Processing and Manufacturing
5.72.1.4 Factory Mobile/Portable/Control Configuration (Staging)
5.72.1.5 Factory Acceptance Testing
5.72.1.6 Mobile and Control Station Equipment Installation
5.72.1.7 Radio Subscriber Roaming Optimization
5.72.1.8 Field Acceptance Testing
5.72.1.9 Technical and Operational Training
5.72.1.10 Radio Subscriber Warranty Support
5.72.1.11 Radio Subscriber Post Warranty Support Period

5.72.2 The following defines, in detail, the expected project phases for the planning, design, manufacture, installation, optimization and testing of the PSERN.

5.73 Project Initiation

5.73.1 Proposer Project Manager shall initiate the implementation process. Proposer shall conduct the project initiation meeting(s) with Owner representatives.

5.73.1.1 Introduction of the Proposer and Owner Project Managers as the single point of contact with authority to make routine project decisions
5.73.1.2 Introduction of all radio subscriber project team participants
5.73.1.3 Review of the roles of the project participants to identify communication flow and decision-making authority between participants
5.73.1.4 Review of the overall radio subscriber project scope and objectives
5.73.1.5 Review of the resource and scheduling requirements.
5.73.1.6 Review the draft radio subscriber project schedule addressing milestones and key deliverables
5.73.1.7 Review of the Project Management Plan and processes

5.73.2 This task is considered complete when the Project Kickoff Session has been held with Proposer and Owner representatives in attendance, and when project scope, schedules, procedures, roles and responsibilities have been documented and agreed upon.
5.74 Detailed Design Development And Review

5.74.1 After the kick off meeting, Proposer shall meet with Owner’s project team to achieve written agreement on the radio subscriber implementation plan, identify any special system or product requirements and their impact on radio subscriber implementation, identify final radio subscriber unit counts and configurations, and refine the implementation plan and plan documentation.

5.74.2 Proposer shall provide, at a minimum, the following documents to Owner for its review and approval:

- Document Index
- Project Schedule
- Statement of Work
- Radio Subscriber Equipment Description
- Frequency Plan
- Radio Subscriber IP Plan
- Radio Subscriber Equipment Lists
- Draft Subscriber Programming Templates
- Factory Acceptance Test Plan (FATP)
- Mobile and Portable Equipment Inspections (100%)
- Mobile and Portable Measured Values (2 samples of each type of supplied subscriber radio)
- Radio Subscriber Functional Testing
- Field Acceptance Test Plan (FATP)
- Mobile and Portable Equipment Inspections (100%)
- Mobile and Portable Measured Values (100%)
- Radio Subscriber Functional Testing
- Training Plan
- Transition Plan
- Preventative Maintenance Plan
- Radio Subscriber Administrator documentation and programming parameters

5.74.3 During this period, Owner shall:

- Provide access to facilities requiring radio control station installation
- Coordinate mobile installation locations and point of contact for mobile installation locations with the Contractor.

5.74.4 This phase is complete when all documentation and detailed documents associated with this phase have been delivered to Owner, reviewed and approved by Owner, and signed by the designated representative from Owner. After acceptance, Proposer shall schedule all factory orders for shipment to meet the approved project schedule.
5.75 Finalize Project Schedule

5.75.1 The objective of this task is to finalize the preliminary Project Schedule contained in the Proposal and as amended in the Project Initiation meeting. This finalization shall be based on the requirements identified in the Detailed Design Development Review and shall take into consideration the project objectives, plans, schedules, activities, approvals, priorities and interdependencies among tasks. The Radio Subscriber Project Schedule shall be finalized at the end of the Detailed Design Development and Review process and mutually agreed upon between the Parties. The resulting document defines the specific project tasks to be completed and verifies the final Project Schedule for radio subscriber equipment implementation.

5.75.2 The accepted Project Schedule shall become the governing Project Schedule incorporated into the contract, and is subject to change only upon mutual agreement of Proposer and Owner. The acceptance of the project schedule shall be the final activity of Detailed Design Development and Review process.

5.76 Finalize Acceptance Test Plan (ATP) Procedures

5.76.1 Draft acceptance test plans shall be provided in the Proposal. Proposer and Owner shall finalize ATP documents in the Detailed Design Development and Review to provide the required procedures to be used for testing the functionality and performance of the radio subscribers. The ATP documents establish the sole framework for radio subscriber acceptance. The tests shall validate the functional performance of the radio subscribers. The ATP includes the acceptance criteria to ensure the equipment operates according to the specifications, design and standards identified in the Proposal.

5.77 Subscriber Fleet Mapping, Templates, And Programming

5.77.1 Proposer shall work with Owner to develop the fleet map for all radio subscribers and the participating agencies. This work takes place during the Detailed Design Development activity and extends beyond its completion. Proposer shall conduct meetings with Owner to define fleet mapping, discuss effective organization of talkgroups, and detail how to set up the radio subscriber fleet map to operate in the system.

5.77.2 Based on the system fleet map, the configurations for the radio subscribers shall be developed by Proposer for programming into the radio subscriber equipment. All elements of subscriber radio programming shall be done using only Owner approved and signed fleet map and programming templates.

5.77.3 During system implementation, Proposer shall support and guide Owner in its efforts to define the fleet mapping and programming requirements. The infrastructure equipment, mobiles, portables, and any other fixed network equipment in the system shall be configured based on this fleet map. Proposer shall include development of all programming templates for the subscriber equipment.

5.77.4 All Fleet Mapping, Template and Programming data is considered to be security sensitive information. All personnel assigned to System Fleet Mapping, Template creation and Programming tasks shall be required to undergo a background investigation and sign an individual Non-Disclosure Agreement (NDA).
5.78 Order Processing and Radio Subscriber Equipment Manufacture

5.78.1 After the Contract Design Review and subsequent contract execution, Proposer shall process orders for equipment and begin equipment manufacturing.

5.79 Factory Staging

5.79.1 Proposer shall provide a representative sample of all offered subscriber radio equipment for factory staging.

5.79.2 Proposer shall assemble radios at a single location. After assembly, the Proposer’s Staging Technicians and Engineers shall power up the equipment, load software, set parameters, program, configure and optimize the radio equipment. Radio parameters shall be set according to inputs from the Proposer design team. System software and system features shall be tested and validated. All system parameters shall be set according to specifications to verify proper operation and functionality. These parameter settings shall be recorded and documented to provide baseline information to the field integration team.

5.80 Factory Acceptance Testing

5.80.1 Upon satisfactory completion of tests, Proposer shall coordinate with Owner for a factory visit to participate in radio subscriber testing. This visit shall provide Owner with the opportunity to observe the radio subscriber equipment programmed and optimized as an integrated system and to test in a hands-on manner, most functionality and features of the radios that are capable of operation in a factory environment. Factory acceptance testing shall comprise of four (4) elements. These are:

5.80.1.1 100% Inspection by Proposer and County of all radio subscriber equipment

5.80.1.2 5% Selective measurement of all radio subscriber equipment parameter settings by Proposer and review of all performance and conformance measurements by Owner. Measurements shall be witnessed by Owner representative.

5.80.1.3 Functional testing of all features present in the Proposal and purchased by Owner as a joint activity between the Owner and Proposer.

5.80.2 At completion of system staging Factory Acceptance Testing, Proposer shall inventory the radio subscriber equipment. Proposer shall update the inventory database with this information to assist in tracking upon delivery to the field.

5.81 Mobile Installation and Radio Programming

5.81.1 Proposer shall program and install mobile radios in vehicles and control stations per, based upon a mutually agreed upon schedule. Installation locations shall exist at multiple locations across King County. All mobile installation locations shall have sufficient space, lighting, heating, adequate shelter, and power for Proposer to safely perform the installation work.

5.81.2 All Fleet Mapping, Template and Programming data is considered to be security sensitive information. All personnel assigned to System Fleet Mapping, Template creation and Programming tasks shall be required to undergo a background investigation and sign an individual Non-Disclosure Agreement (NDA)
5.81.3 To assist the Proposer with estimating workload and related man-hours to perform mobile installations, the Owner has provided an opinion on feasible installation rates shown in Table 5.82-1 below. These estimates are based upon operational and logistical limitations with each respective subsystem entities. Proposers are encouraged to use this data for baseline calculations in their pricing proposal.

<table>
<thead>
<tr>
<th>Agency</th>
<th>Fire</th>
<th>Police</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPSCA</td>
<td>2 vehicles/day</td>
<td>4 vehicles/day</td>
<td>4 vehicles/day</td>
</tr>
<tr>
<td>King County</td>
<td>3 vehicles/day</td>
<td>5 vehicles/day</td>
<td>3 vehicles/day</td>
</tr>
<tr>
<td>City of Seattle</td>
<td>1 vehicles/day</td>
<td>3 vehicles/day</td>
<td>2 vehicles/day</td>
</tr>
<tr>
<td>Valley Com</td>
<td>3 vehicles/day</td>
<td>5 vehicles/day</td>
<td>1 vehicles/day</td>
</tr>
</tbody>
</table>

Table 5.81 Mobile Installations

5.82 Radio Subscriber Optimization

5.82.1 Proposer shall verify that all radio subscriber equipment is operating properly and that all parameters are properly set once installation in the field is complete.

5.82.2 Proposer shall optimize each radio subscriber individually. All performance parameters (modulation fidelity, frequency error, Tx & Rx BER, etc.) shall be checked to verify factory settings.

5.82.3 All mobile and control station radio subscribers shall have forward and reflected power checked by Proposer after connection to the antenna systems to verify that they meet the FCC requirements and are within Proposer design tolerances.

5.82.4 All communication interfaces between devices shall be verified for proper operation and all features and functionality shall be tested by Proposer to ensure that they are functioning according to the manufacturer’s specifications and per the final configuration established during system staging.

5.83 Radio Subscriber Train-the-Trainer Training

5.83.1 Subscriber radio user training shall be provided for technical personnel, dispatcher personnel, and end user per the selected training courses identified in the Proposal. Training shall take place at various locations within King County. The optimum timing of when training takes place shall be established by the Proposer.

5.83.2 All provided training materials shall be customizable electronic media and shall be for use at the Owner’s discretion.

5.83.3 Proposer shall conduct their training courses to thoroughly train PSERN users and Owner technical personnel on the operation and support of the radio subscriber equipment.

5.84 Field Acceptance Tests

5.84.1 Field acceptance testing shall comprise of three (3) elements. These are:

5.84.1.1 100% Inspection by Proposer and County of all installed radio subscriber equipment
5.84.1.2 100% measurement of all radio subscriber equipment parameter settings by Proposer, and review of all performance and conformance measurements by the Owner. Measurements shall be witnessed by Owner’s representative technical staff.

5.84.1.3 Functional testing of all features present in the Proposal and purchased by Owner as a joint activity between the Owner and Proposer.

5.84.2 Radio Subscriber acceptance tests shall be performed when the subscriber optimization is complete. The field acceptance test shall verify full subscriber functionality. These tests shall verify radio subscriber roaming and subscriber affiliation.

5.85 Radio Subscriber Project Finalization

5.85.1 Proposer shall work with Owner to resolve punch-list items documented during radio subscriber unit installation and testing in order to meet all criteria for final acceptance. Owner shall approve resolution of all punch list items.

5.86 Factory Staging Documentation

5.86.1 Proposer shall create or update the following documents at the conclusion of system staging:

5.86.1.1 Programming templates

5.86.1.2 Mobile and Control Station Interconnection drawings up to Proposer demarcations

5.86.1.3 Manufacturer’s standard operator manuals

5.86.1.4 Manufacturer’s standard technical service manuals

5.86.1.5 Interconnection cable description and inventory

5.86.1.6 Printout of equipment parameters

5.86.1.7 Inventory with serial numbers and installation reference

5.86.1.8 Software/firmware version numbers

5.87 As-Built Radio Control Station Documentation

5.87.1 Proposer shall supply as-built documentation for all supplied radio control stations. Documentation shall be provided as both printed copies and as PDF documents. Documentation shall be provided in Owner maintainable native formats (MS Office, Visio, AutoCAD or other formats) or PDF’s where the provided documentation depends on Proposer-proprietary formats.

5.87.2 One (1) full copy of each site’s radio control station as-built drawing set shall be left at each site along with a copy of all applicable equipment and system manuals as a permanent reference. One (1) additional copy shall be provided for central retention, along with softcopies of all documents in both their native formats and as PDF’s.

5.87.3 A final, fully integrated as-built drawing set shall be provided 90 days following completion of the project and prior to issuance of final payment.

5.87.4 The documentation shall, at a minimum, consist of:

5.87.4.1 Standard Equipment Manuals

5.87.4.2 System drawings:
5.87.4.3 Plan and elevation views of the equipment installation at the radio site
5.87.4.4 Equipment inter-cabling diagrams for each site
5.87.4.5 Demarcation wiring lists
5.87.4.6 Programming and parameters setting data sheets
5.87.4.7 Equipment by site
5.87.4.8 Site inventory lists
5.87.4.9 Software versions and equipment wiring by equipment site
5.87.4.10 Radio Licenses
5.87.4.11 Field ATP test sheets and results
5.87.4.12 Maintenance Records
5.87.4.13 Warranty information

5.88 Radio Subscriber Equipment Manuals

5.88.1 Proposer shall provide equipment Operation and Technical Service manuals covering both standard and optional features. Manuals shall be provided in sufficient quantities to meet Owner requirements. Manuals shall be provided as PDF documents, and where available, in printed copies.
6 MICROWAVE AND MPLS

6.1 Introduction

6.1.1 The Owner desires to build the foundation of a microwave system to meet the communications needs of Owner over the next ten (10) to twenty (20) years or more. This microwave network shall have sufficient data throughput to meet PSERN initial capacity requirements, as well as providing 25% additional spare capacity.

6.2 Microwave Required Committed Information Rates (Capacity)

6.2.1 The replacement microwave transport system shall be designed and implemented with sufficient capacity to accommodate the PSERN over the next fifteen (15) years without software or hardware upgrades. Additional capacity shall be designed into the system to accommodate projected traffic from other governmental agencies that desire backhaul capabilities. Proposers shall provide pricing for capacity plans as outlined below. In addition, Proposers may suggest other capacities based on their own assessments of the network traffic requirements.

6.3 High Capacity Microwave Subsystems (150/300 Mb)

6.3.1 Are defined typically as main inter-site links, and shall be designed for the following minimum committed information rates:

6.3.1.1 Minimum 150Mb/s (each direction)

6.3.1.2 Optional 300Mb/s (each direction)

6.3.1.3 Long term upgrade path for future needs

6.4 Low Capacity Microwave Subsystems (less than 150 Mb)

6.4.1 Defined typically as one-way spurs, and shall be designed for the following minimum committed information rates:

6.4.1.1 Minimum 45Mb/s (each direction)

6.4.1.2 Optional 150Mb/s (each direction)

6.4.1.3 Long term upgrade path for future needs

6.5 Licensed Microwave Frequency Band Preference

6.5.1 The Puget Sound region area is infamous for its microcell weather patterns and lengthy precipitation seasons, which can adversely affect microwave performance in the higher frequency bands. Proposers are cautioned that severe localized weather convergence conditions in central Puget Sound can result in severe path fade conditions. These localized conditions are not adequately documented in North American rain rate data. Path design shall include additional engineered path margin to accommodate these local conditions.

6.5.2 The Owner highly prefers use of 6 GHz microwave frequencies only. However, due to congestion in the 6 GHz band in the Puget Sound region, 10/11 GHz operation may be acceptable where coordination of 6 GHz channels is not feasible. Microwave solutions operating on unlicensed microwave bands (2.4 GHz/5.8 GHz), and licensed 4.9 GHz, 18 GHz and 23 GHz are not acceptable for the primary microwave network and shall not be proposed.
6.5.3 The Owner has an existing wide-area microwave transport system. Some of these existing links may need to remain in place and be integrated with the new system while maintaining PSERN’s reliability requirements of 24/7 operations. Some links may be replaced with the new system.

6.5.4 To assist on the design and implementation of the replacement microwave system, reuse of existing Owner-coordinated channels and paths, when practical from design, engineering and cost standpoint, is encouraged and may be required as a result of spectrum scarcity in the Puget Sound region. Proposers shall have sole responsibility for proposing a microwave solution that is licensable and shall have responsibility for securing all FCC licenses.

6.6 Microwave Required Reliability

6.6.1 Reliability is essential for mission critical voice communications where first responders are relying on instant communications 24 hours a day, 365 days a year. As this network will be used for the transport of critical public safety radio and data traffic, no single point of failure shall be permitted in the microwave node that could be traffic impacting. As a part of these goals, it is desirable that the proposed microwave radio includes redundant and physically diverse control and management cards and switch interface cards. It is also desirable that control, management and switch interface cards be hot-swappable. Proposers shall describe these capabilities in the Proposal.

6.6.2 The requirements for specified reliability are for a per-hop, two-way availability at the required capacity per year of 99.999% which translates to a Bit Error Rate (BER) of $1 \times 10^{-6}$. Local environmental conditions and North American path engineering requirements must be met by the proposed design.

6.6.3 Microwave antenna resources shall be dedicated to the future PSERN and shall not be shared with any existing co-located microwave equipment. Proposers shall detail how their solution shall meet the required reliability specification, such as:

6.6.3.1 No single point of failure within the IP network
6.6.3.2 Use of loop protection on all radio site and communications center connections
6.6.3.3 Minimize isolated spur topology when practical
6.6.3.4 Hardware redundancy
6.6.3.5 Link redundancy (n+1, 2+0, etc.) or bandwidth enhancement through overlay of additional radios
6.6.3.6 Diversity antennas where required for difficult paths

6.6.4 The proposer shall state how they shall meet the reliability specification. Lastly, the Proposer shall disclose their design assumptions, fade margin values and ITUI rain region data in their submitted path link designs and shall be available to discuss these assumptions and calculations with the Owner.

6.7 Required Minimum Performance Levels for T1

6.7.1 5 msec. latency on site links
6.7.2 B8ZS coding, ESF framing
6.7.3 BER of better than $1 \times 10^{-7}$
6.7.4 Availability 99.999%

6.8 Latency/Delay

6.8.1 The latency or delay characteristics of the proposed digital microwave network shall exceed, with significant margin, the maximum latency requirements of the PSERN. In order to ensure that the designed solution meets this requirement, Proposers shall provide details on their methodology used to calculate overall system delays, including encapsulation delay, switching delay and propagation delay. For consistent in calculated information, assume a typical frame size of 512 Bytes.

6.8.2 Example: Total Latency = \{ (encap latency \times 2) + (Switch latency \times n) + (OTA latency \times (n - 1)) + (Framing Latency \times 2) \}

6.8.3 The assumed maximum latency permissible should be 8ms or lower

6.9 Considerations for Latency Delay Calculations

6.9.1 Table 6.9 below outlines considerations and assumptions for Proposers on digital microwave delay calculations. Proposers shall detail their assumptions, if different, for their submitted traffic performance analysis.

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Unit</th>
<th>1 Hops</th>
<th>3 Hops</th>
<th>10 Hops</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDM ingress, 32xDS1 module</td>
<td>0.63 ms</td>
<td>0.63 ms</td>
<td>0.63 ms</td>
<td>0.63 ms</td>
</tr>
<tr>
<td>MSS Core</td>
<td>0.032 ms</td>
<td>0.064 ms</td>
<td>0.128 ms</td>
<td>0.352 ms</td>
</tr>
<tr>
<td>Modem (TX + RX)</td>
<td>0.3 ms</td>
<td>0.3 ms</td>
<td>0.9 ms</td>
<td>3.0 ms</td>
</tr>
<tr>
<td>TDM egress, 32xDS1 module</td>
<td>2.5 ms</td>
<td>2.5 ms</td>
<td>2.5 ms</td>
<td>2.5 ms</td>
</tr>
<tr>
<td>Free space propagation per mile</td>
<td>0.0053 ms</td>
<td>0.1325 ms</td>
<td>0.3975 ms</td>
<td>1.325 ms</td>
</tr>
<tr>
<td>Total Latency</td>
<td>3.6 ms</td>
<td>4.6 ms</td>
<td>7.8 ms</td>
<td></td>
</tr>
</tbody>
</table>

Table 6.9 Example Delay Calculations

6.10 Jitter

6.10.1 Variations in delay between links can impair intelligibility of simulcast radio systems. Proposers shall provide details on jitter specifications for proposed solution.

6.10.1.1 Maximum permissible jitter less than or Equal to 10ms Simulcast Sub-site Links

6.10.1.2 Maximum permissible jitter less than or Equal to 20ms End to End

6.11 Packet Loss

6.11.1 Packet Loss performance refers to "Type-P-One-Way-Packet-Loss" as defined in RFC 2680, section 2.4. The limits established should be

6.11.1.1 No more than 0.1% end to end (additive)

6.11.1.2 End-end = 0.02% (additive)
6.12 Power Supply Requirements

6.12.1 In order to support standardization of PSERN radio sites to a common power plant design, the majority of the supplied microwave radio equipment shall operate from a -48 VDC power supply system. If proposed microwave equipment requires fully filtered power, Proposers shall make a note of such a requirement. If power requirements permit the use of a wide range of power supply voltages, suppliers shall provide details of the voltage ranges supported.

6.12.2 For a limited number of locations, AC power shall be required. For these locations, the proposed microwave radio product shall include redundant power supplies.

6.13 Microwave Radio Physical Requirements

6.13.1 The proposed microwave radio product shall allow for flexible configuration, ease of service, and high reliability. Proposers shall describe the functionality of the proposed microwave radio package and how it scales in size to support different interface card types.

6.13.2 It is desired that the proposed microwave radio solution be compact. Proposers shall state the size of the proposed product.

6.14 Microwave Antenna Ice Protection

6.14.1 The proposed microwave antenna design and installation shall include tower-mounted ice shields to protect antennas and radomes from ice fall damage. All tower loading studies shall incorporate the ice fall protection hardware component weight and radials as included appurtenances in all tower loading studies performed.

6.14.2 Microwave radios are available in indoor, split mount and compete outdoor unit models. Unless the Proposer can demonstrate significant performance, maintenance, safety or cost benefit to the Owner, the desire is to have microwave transceiver in indoor unit split configurations with external waveguide wherever possible.

6.14.3 Physical space is at a premium in most if not all of the existing or potential new PSERN facilities. As a result, a compact form-factor for the proposed microwave equipment is highly desired.

6.15 Ethernet Microwave Requirement

6.15.1 The PSERN shall consist of an APCO P25 Phase II TDMA trunked 700/800 MHz radio system with a multiple simulcast cells and multicast radio sites as outlined in other sections of this RFP. It is required that the proposed radio network shall utilize Ethernet IP Microwave transport technology without any absolute requirement for circuit-switched TDM architecture.

6.15.2 Each microwave radio node included in the Proposal shall include the following attributes:

6.15.2.1 Redundant configuration (receiver and transmitter) including control and forwarding cards, redundant power supplies, redundant cooling fans (if used).

6.15.2.2 A minimum of four (4) SFP based Gigabit Ethernet ports. To ensure no single point of failure, these ports shall be divided between 2 physically diverse Ethernet cards in the chassis.
6.15.2.3 A minimum of twelve (12) 10/100BaseT ports. To ensure no single point of failure, these ports must be divided between 2 physically diverse Ethernet cards in the chassis.

6.16 Network Routing

6.16.1 The microwave IP transport system shall be supplied with the appropriate hardware by the Proposer to support routing and management of IP traffic throughout the network. The offered routers shall be thoroughly tested and approved for use with the proposed microwave transport. The use of commercial off the shelf (COTS) equipment is preferred and acceptable with the expectation that models selected by the Proposer based upon quality, performance and reliability of enterprise-grade or higher product platforms.

6.16.2 Specified routers shall have adequate quantities of Ethernet ports for the proposed design with spare ports for additional expansion.

6.16.3 IP routing equipment shall support common industry-standard routing protocols in lieu of proprietary derivations. Examples include the following:

6.16.3.1 Routing Information Protocol (RIP)
6.16.3.2 Open Shortest Path First (OSPF)
6.16.3.3 Interior Gateway Routing Protocol (IGRP)
6.16.3.4 Intermediate System to Intermediate System (IS-IS)
6.16.3.5 Generic Routing Encapsulation (GRE)
6.16.3.6 Border Gateway Protocol

6.17 Network Redundancy using Split Loop Topology per Simulcast Sub-System

6.17.1 The network topology shall be designed so as to allow all sites in a simulcast subsystem to utilize a single microwave transport loop. In the event that multiple microwave failure occur, this ensures that the simulcast subsystem can continue operation at maximum capacity and coverage.

6.17.2 The microwave transport topology shall be designed to support most-efficient use of bandwidth and traffic management within a simulcast subsystem. This is to permit efficient radio subscriber call processing with a minimum of bandwidth.

6.17.3 The Proposer shall demonstrate how their offered microwave transport topology supports this configuration.

6.18 Network Quality of Service (QoS) and Class of Service (CoS)

6.18.1 The proposed microwave transport shall support multiple Quality of Service and Class of Services and must be capable of dropping lower priority packets when required and designating different paths for network traffic flow based upon payload priority. The proposed equipment shall support these capabilities by implementing QoS and CoS techniques defined by applicable IEEE standards.

6.18.2 These include:

6.18.2.1 Ethernet Standard - 802.3
6.18.2.2 Service Layer Orthogonal Amplitude Modulation - 802.1ag
6.18.2.3 Layer 2 (tunnel and pseudo-wire), Layer 2.5 (priority code point) and VLAN tagging
6.18.3 The Proposer shall detail their offered equipment’s support for QoS and CoS and conformance to the IEEE standards outlined above.

6.19 Disclosure of Requirement for TDM DS1/DS3 Circuit-Switched Technology

6.19.1 Any P25 Phase II TDMA trunked radio network proposal requiring TDM circuit-switched architecture or emulation of circuit switching (“pseudo-wire”) for normal operation must be fully disclosed in detail with amplification on how to achieve reliable operation over IP-based microwave transport architecture. Proposers shall disclose if TDM circuiting is required for interoperability radio systems or any other aspect of the proposed system. Proposers are solely responsible for ensuring that the proposed microwave system is fully compatible with and fully functional with their offered radio network infrastructure.

6.20 Required Support for Fiber Optic Interfaces

6.20.1 The proposed microwave transport shall support interface to fiber optic media to include an OC3 MUX interface. The optical interfaces shall be G.957 / G.825 compliant.

6.21 Low Rate and Legacy Interface Requirements

6.21.1 At the time of this RFP, there is a desire to have available the following interface types present at the microwave radio (without requiring use of MPLS or external channel bank). This requirement may evolve during the post contract design process into a requirement for a pure IP solution that does not require provisioning of the radio with these specific legacy interfaces. Regardless, Proposers shall identify if their proposed microwave solution includes the ability to support these specific interfaces.

6.21.1.1 10/100BaseT Ethernet
6.21.1.2 SFP based 1000Base-X Gigabit Ethernet ports
6.21.1.3 OC3 for POS
6.21.1.4 OC3 for ATM
6.21.1.5 OC3 for Circuit emulation over MPLS (channelized down to the DS0 level)
6.21.1.6 DS3 (for PPP termination)
6.21.1.7 DS3 for TDM Circuit Emulation (channelized down to the DS0 level)
6.21.1.8 DS3 for ATM
6.21.1.9 DS1 for TDM Circuit Emulation over MPLS (channelized down to the DS0 level)
6.21.1.10 DS0 2/4 wire E&M
6.21.1.11 DS0 Serial Data Interface - RS232, V.24, V.35, and X21
6.21.1.12 DS0 FXS/FXO
6.21.1.13 C37.94
6.21.1.14 G.703 co-directional
6.21.1.15 CWDM mux (specify number of channels of add-drop)
6.21.2 Proposers shall describe any DS0 cross connect capability present in the provided circuit emulation capability if available. Where the proposed microwave radio includes a native cross connect capability, Proposers shall clearly indicate if their product offering allows for any DS0 in the network be cross connected to any other DS0 slot on a T1, DS3, or OC3 card.

6.21.3 Proposers shall also describe available loop switching capabilities included in the proposed microwave radio product, as well as the ability to support external loop switches. Specific product information shall be included in the Proposal that clearly identifies the external loop switch product and the cost of adding loop switching.

6.22 Modular Construction

6.22.1 Microwave transceiver solutions designed with a modular form factor is preferable. The ability for PSERN technicians to efficiently perform maintenance or repair with line replaceable modules (ex. Rx, Exciter, PA, Power supply, etc.) is desirable. In addition, modularization of transceiver sub-components aids in planning and managing system spares. The Proposer shall detail any modular components in the offered solution to meet this preference.

6.23 Scalability

6.23.1 Solutions shall provide scalability as much as possible to provide easy capacity upgrades to meet increasing traffic demands, and provide maximum flexibility for the Owner to implement future technologies. This may include overlay of additional channels/microwave radios on specific hops, use of alternate polarities, or other options that can significantly increase the available bandwidth.

6.23.2 Proposers shall include a description cost and complexity of the following additions to their product:

6.23.2.1 Adding 16 T1s to the microwave radio

6.23.2.2 Add an additional 16 ports of Gigabit Ethernet SFP slots

6.24 Microwave Antenna Systems

6.24.1 All antenna systems, including antenna waveguide, entry port boots, cable attachments, transitional flexible waveguide, and top of rack couplers or other antenna system elements shall be provided as a part of the microwave portion of the Proposal. Antenna mounts as required to attach the provided microwave antennas to each tower, either existing or new shall also be provided.

6.25 Microwave Antenna Installation Hardware Quality of Manufacture

6.25.1 All physical and mechanical installation hardware components used for the attachment of microwave antennas, waveguide and related components shall adhere to the manufacturer’s recommendation, be of highest mechanical strength and must be constructed of a corrosion-resistant alloy or have an anti-corrosion finish. The Proposer shall detail the ASTM grade of hardware components to be used in the mechanical installation of all microwave antenna and waveguide components.

6.26 Structured Cable/Waveguide Management

6.26.1 The quality of design and installation of the microwave waveguide assemblies have long-term effects on tower physical considerations and overall system reliability. The Proposer shall provide an outline of structured cable management techniques utilized with evidence of adherence to manufacturer recommendations.
and/or industry standards. The lengths of all waveguide runs with distances between connectors, couplers, flanges, antennas and transceivers shall be recorded and made available for review.

6.27 Required Use of High-Performance Antennas

6.27.1 Ability to license the proposed microwave solution in the crowded Puget Sound region, provide maximum availability and highest committed information per microwave link, and avoid receiving or causing interference to other microwave networks is a key design requirement for the PSERN microwave transport system. Accordingly, unless otherwise precluded by tower loading or other design consideration, high-performance dish antennas shall be specified and used at all PSERN radio sites. Diversity antennas should be proposed, as required, to meet path design criteria.

6.27.2 Unless otherwise approved by Owner, proposed models of microwave antennas shall be selected for highest RF performance, strongest mechanical design and greatest environmental survivability within a manufacturer’s product line. Substitution of economy, consumer- or enterprise-grade antennas or mounting components shall not be acceptable.

6.28 Required Pressurization / Dehydration Equipment and Alarm Monitoring

6.28.1 The Proposer shall include all required microwave waveguide and antenna pressurization and dehydration equipment including dehydrators, gauges, manifolds, lines and any other fittings. Dehydration and pressurization equipment alarms shall be delivered to the microwave alarm monitoring NMS.

6.29 Site Alarm Inputs and Control Outputs

6.29.1 The proposed microwave radio shall include an external alarm input/control output capability that supports dry contact inputs, relay outputs, and analog level inputs, with scaling of the analog inputs to provide monitoring of typical site analog levels. These alarm indications shall be capable of being delivered to the proposed Network Management System (NMS).

6.30 Microwave Network Management System (NMS)

6.30.1 The Owner requires a comprehensive microwave network management solution. This requirement may be a microwave-network/MPLS switch-only network management system and may also be a comprehensive network management solution that encompasses all elements of the radio system, microwave network, radio site monitoring (including facility and equipment alarms) and the MPLS switching layer. Proposers shall include a microwave network-only/MPLS NMS solution in the proposal. If more comprehensive system level NMS solutions are available, these shall be included as priced options to the Proposal.

6.30.2 The Proposal shall include a complete Network Management System (NMS) that provides provisioning, network, nodal, and per-service fault management, per-service accounting functionality, and per-service reporting tools. Proposers shall describe fully how their fault monitoring solution operates.

6.31 NMS Alarm Monitoring and System Diagnostics

6.31.1 The basic NMS shall provide for the monitoring of all microwave network elements from up to five central technical locations (connected to the microwave network). Additionally, it is desired that technicians working at locations where the network exists have the ability to monitor network health and well-being from a connected...
laptop. Technician access to the NMS is also required from suitably equipped, secure laptops (VPN level security) from any location with reliable Internet access.

6.31.2 The proposed microwave NMS solution shall include the ability to send all major and minor system alarms to wireless devices used by technical staff and system managers. These alarm indications shall allow filtering by type and severity of impairment. Alarm notifications shall be capable of being sent as:

6.31.2.1 E-mail message with descriptive information concerning the and alarm including location information
6.31.2.2 Text message (SMS) with descriptive information concerning the and alarm including location information

6.31.3 The proposed Network Management System (NMS) shall be capable of integration with third-party SNMP based NMS products for alarm purposes and provide alarm detail information. As a minimum, the proposed solution shall process the following alarms:

6.31.3.1 Power Output / High SWR
6.31.3.2 High Bit Error Rate (BER)
6.31.3.3 Loss of signal on a feeder (input)
6.31.3.4 Loss of RF signal on receive
6.31.3.5 Loss of sync on the link
6.31.3.6 Loss of frame on the link
6.31.3.7 Low Receiver Signal Level (RSL)

6.31.4 The proposed NMS solution shall include a high availability configuration that may include redundant NMS systems and support of physically diverse network operation centers. Proposers shall describe their ability to provide high availability configurations and these configurations should be included in the proposal as a priced option.

6.31.5 Proposers shall describe how the proposed solution recognizes the failure of a microwave path link even though the microwave radio’s Ethernet, T1, DS3, or OC3 port is still operational.

6.32 Dedicated Full-Duplex Technician/Maintenance Audio Circuit “Order-Wire”

6.32.1 The offered microwave transport solution shall incorporate a dedicated audio intercom functionality between any two microwave transceivers for the purpose of site-to-site technician communications- also known as “order-wire” circuits. Each transceiver shall support order-wire communications through a telephone style handset and also provide for an external local monitor speaker with adjustable volume control to permit audio communications in elevated site noise levels.

6.33 RF Spectrum Analyzer with Visual Event Logging

6.33.1 The Proposed microwave transceiver solution shall incorporate a real-time integrated RF spectrum analyzer with waterfall display or equivalent time-domain event recording (“paper-less chart recorder”). This capability shall allow PSERN radio technicians, through a simple ethernet-enabled browser application, to visually observe the microwave RF spectrum of interest in the licensed band of operation and also view, record and retrieve RF events (ex. fades, interference,
adjacent channel activity, etc.) for the purpose of validating link performance and troubleshoot high BER or link failure events. Proposer shall detail the analytical capabilities of their offered solution’s spectrum analysis and recording feature.

6.34 Remote Updating of Microwave Transceiver Software

6.34.1 Due to the number and often inaccessible location of the Owner’s radio sites, the procedure for updating the software of the proposed microwave transport solution shall be executable remotely via a remote IP connection and software file “push”. It shall not require local technician presence to the equipment to be upgraded.

6.35 Remote Confirmation of Microwave Transceiver Software Revision

6.35.1 The procedure for determining the currently installed software or firmware revision of the proposed microwave transport solution shall be executable remotely via a remote IP connection and software file download. It shall not require local technician presence to the equipment to be viewed or downloaded.

6.36 Microwave Radio Craft Interface Requirements

6.36.1 The Owner requires a useful craft interface based on technician use of a laptop computer. It is desired to use a web browser based interface where possible. If a proprietary craft interface product is required, Proposers shall clearly describe the proprietary device or software. Proprietary craft interface devices and software, if required, shall be included in the microwave section of the Proposal.

6.36.2 Proposers shall describe the NMS system/craft interface ability to measure latency, jitter, packet loss, or round trip delay.

6.37 Ease of Use

6.37.1 The relative ease of use of the microwave hardware and the data network hardware is significant in evaluating an offered solution. Proposers shall detail solutions used for managing the new microwave network using a single management tool utilizing a simple Graphical User Interface (GUI). PSERN technicians shall be able to configure, optimize, monitor and track all physical and virtual links within a single GUI.

6.38 Security

6.38.1 As with any public safety communications system, security is of utmost importance for the Owner. Proposers shall include information regarding security features of the proposed NMS and craft interface solution to include logon password protection and authentication schemes.

6.39 Review and Inspection of Work

6.39.1 The Owner reserves the right to conduct independent audits and inspections of the quality of work performed in the microwave system installation. The installer shall document proof of their work photographically and shall submit an archive of images to the Owner for review.
6.40 Multiple Protocol Label Switching (MPLS) Network System Requirements

6.40.1 General System Requirements

6.40.1.1 Due to the complex nature of the King County environment, the need for a network backbone that can support multiple entities with flexibility, security, and communication integrity is required. Internet Protocol (IP) / Multiple Protocol Label Switching (MPLS) network with a network control and management system is the required solution.

6.40.1.2 Table 6.40 describes the environment that the proposed system shall need to support.

<table>
<thead>
<tr>
<th>Table 6.40 System Requirements</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Communication Centers</td>
<td>12</td>
</tr>
<tr>
<td>Number of Microwave Sites</td>
<td>All</td>
</tr>
<tr>
<td>Number of Entities to be supported</td>
<td>20</td>
</tr>
<tr>
<td>Miscellaneous or Other Facilities</td>
<td>10</td>
</tr>
<tr>
<td>Projected Growth</td>
<td>25%</td>
</tr>
</tbody>
</table>

6.40.1.3 The proposed IP/MPLS Network solution shall use the proposed microwave system along with any future optical fiber networks.

6.40.1.4 The proposed IP/MPLS Network shall provide all necessary equipment to satisfy the requirements specified in this document and the logical configuration shown in Layer 3: Network Layer of the Figure 6.40.

![Figure 6.40 IP/MPLS Network Equipment](image-url)
6.41 MPLS Network Technical And Performance Specifications

6.41.1 Network System Requirements

6.41.1.1 The goal of the IP/MPLS Network is to provide an overlay network for the transport network below. The IP/MPLS overlay network shall provide the following:

6.41.1.1.1 Guaranteed level of Quality of Service (QoS), especially constraints for delay and delay variation, for maintaining Service Level Agreements for the different entities using the IP/MPLS network

6.41.1.1.2 Guaranteed logical isolation between entities using IP/MPLS network

6.41.1.1.3 Automatic traffic re-routing routing in case of physical layer failure

6.41.1.1.4 Hitless in-service software upgrade (ISSU) on all network devices on the IP/MPLS Network

6.41.1.1.5 Pseudo wire services support for DS1 and DS0 circuits between any of two network locations

6.41.1.1.6 Supports End-to-End “point and click” automatic provisioning of Ethernet, DS1, and DS0 Pseudo wire services on the IP/MPLS network

6.41.1.1.7 Tools for measuring performance metrics of individual services

6.41.1.1.8 “Point and click” automatic report generation for circuit utilization accounting

6.41.1.1.9 Automate network performance tests and alert, if certain performance thresholds are not met

6.41.1.1.10 Unified Network Management System for multiple network operators with different permission levels across multiple locations

6.41.1.1.11 Internet protocol version 4 and version 6 (IPv4 and IPv6) support

6.41.1.1.12 Denial of Service attack protection on controller and services

6.41.1.1.13 Authentication, Authorization, Accounting (AAA) Services for all Network devices

6.41.1.1.14 All MPLS devices shall use a stable, proven, and tested firmware. Specialized firmware designed just for this project requirement is prohibited.
6.41.1.2 Table 6.41 lists all of the required interfaces that shall be supported in the proposed IP/MPLS Network.

<table>
<thead>
<tr>
<th>Interface Type</th>
<th>Physical Connection Type</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/100/1000 Megabit per second Ethernet</td>
<td>Copper and Fiber Optics Small Form-factor Pluggable (SFP)</td>
<td>For both Transport Network interconnection and Local Area Network Connection</td>
</tr>
<tr>
<td>10 Gigabit Ethernet</td>
<td>Fiber Optics Small Form-factor Pluggable (SFP)</td>
<td>For Future Fiber Network</td>
</tr>
<tr>
<td>DS1/T1 interface (Pseudo Wire)</td>
<td>Copper</td>
<td>Performance Guarantee required</td>
</tr>
<tr>
<td>Alarm Interfaces</td>
<td>Dry Copper contact closure</td>
<td>Input / Output physical alarms or contact closure</td>
</tr>
</tbody>
</table>

**Table 6.41 IP/MPLS Network Interfaces**

6.41.2 Routing Protocol Requirements

6.41.2.1 The following minimum routing protocol requirements shall be supported in the proposed IP/MPLS Network.

6.41.2.1.1 Open Shortest Path First (OSPF)
6.41.2.1.2 Intermediate System to Intermediate System (IS-IS)
6.41.2.1.3 Border Gateway Protocol (BGP)

6.41.3 The following protocols are required if it is required by the radio systems design, or else this is a desirable protocol for future growth and expansion.

6.41.3.1 Protocol Independent Multicast – Sparse Mode (PIM-SM)

6.41.4 IP/MPLS System Reliability Requirements

6.41.4.1 This section defines the IP/MPLS network’s requirements necessary for a reliable and dependable network.

6.41.5 IP/MPLS Network Reliability Requirements

6.41.5.1 The IP/MPLS network equipment shall be capable of being connected in either rings, or meshed topologies. The IP/MPLS network shall be automatically rerouted during any physical layer failure without minimum degradation to the end user experience. In other words, during the transition of a physical layer failure, the packet loss and convergence time shall be minimized without any noticeable impact on the end user experience.

6.41.5.2 Provide Virtual Router Redundancy Protocol (VRRP) support

6.41.6 IP/MPLS Network Equipment Reliability Requirements

6.41.6.1 The IP/MPLS network equipment shall meet the following requirements:

6.41.6.1.1 Provide hitless in service software upgrade (ISSU) on all network devices on the IP/MPLS Network
6.41.6.1.2 Provide redundant power supply, controller, network switching, and cooling

6.41.7 Service Reliability Requirements
6.41.7.1 This section defines the IP/MPLS network’s service reliability requirement for the different services offered to the different entities using the network.

6.41.8 Service Definition Requirements
6.41.8.1 The IP/MPLS network shall meet the following service definitions.
6.41.8.1.1 The Service can be defined at a the Ethernet port level
6.41.8.1.2 The Service can be defined at the VLAN level
6.41.8.2 The IP/MPLS network shall support the following service types
6.41.8.2.1 Pseudo wire for TDM services (e.g. DS0, DS1/T1)
6.41.8.2.2 Virtual Private LAN (Local Area Network) Service (VPLS)
6.41.8.2.3 Internet Protocol Virtual Private Network (IP VPN) over IPv4
6.41.8.2.4 Composite Services: capability to mix VPLS with IP routing for Internet access without an external cable

6.41.9 Quality of Service (QoS) Requirements
6.41.9.1 The IP/MPLS network shall provide the following QoS functionality:
6.41.9.1.1 The router shall provide per-service, per-forwarding class ingress queuing and shaping features. The intent is that ingress shaping will absorb the excess offered load, providing it to the service core network at the agreed upon rate
6.41.9.1.2 Minimum of 8 forwarding class queues (ingress and egress) shall be able to be configured on a per service basis each with its own Committed Burst Size (CBS), Peak Information Rate (PIR), Committed Information Rate (CIR), Maximum Burst Size (MBS) and Forwarding Class attributes

6.41.9.2 It shall be possible to classify ingress traffic for a specific service based on the following mappings:
6.41.9.2.1 IEEE 802.1p and IEEE 802.1q mapping.
6.41.9.2.2 IP Differentiated Services Code Point (DSCP) Mapping

6.41.9.3 Ethernet Layer 2 Based Protocol Mapping. The list of Ethernet match criteria should include the following:
6.41.9.3.1 Source MAC address
6.41.9.3.2 Destination MAC address
6.41.9.3.3 EtherType, DSAP (LLC frame type)
6.41.9.3.4 SSAP (LLC frame type)
6.41.9.4 IP Application Mapping.- The list of IP match criteria should include the following:

6.41.9.4.1 Source IP address and mask
6.41.9.4.2 Destination IP address and mask
6.41.9.4.3 IP protocol
6.41.9.4.4 UDP source port
6.41.9.4.5 TCP source port
6.41.9.4.6 UDP destination port
6.41.9.4.7 TCP destination port

6.41.10 Security Requirements

6.41.10.1 The IP/MPLS network shall provide or meet the following Security requirements:

6.41.10.1.1 Protection from Denial of Service (DoS) Attacks in the control plane
6.41.10.1.2 Protection from DoS Attacks on the services
6.41.10.1.3 Abilities to provide encryption to services on the MPLS network
6.41.10.1.4 Abilities to provide or interconnect other security features such as firewalls, intrusion detection systems (IDS), Threat Protection System (TPS)
6.41.10.1.5 Secure Shell for network management

6.41.11 Network Management Requirements

6.41.11.1 The IP/MPLS network shall have two levels of configuration and operational management. The first level of management is the local management on the device. The second is the unified network management system.

6.41.12 Device Network Management Functionality Requirements

6.41.12.1 The IP/MPLS network devices shall provide the following Device Network Management Functionalities:

6.41.12.1.1 Simple Network Management Protocol version 3 (SNMP v3) Support
6.41.12.1.2 All features configurable / manageable via SNMPv3
6.41.12.1.3 Command Line Interface Support (CLI)
6.41.12.1.4 All features configurable / manageable via CLI
6.41.12.1.5 Secure Shell (SSH) access
6.41.12.1.6 Terminal Access Controller Access-Control System Plus (TACACS+) Support or equivalent
6.41.12.1.7 Multiple local configuration file support
6.41.12.1.8 Internet Protocol Flow Information Export (IPFIX) or Netflow support
6.41.12.1.9 ISSU (In Service Software Update)
6.41.12.1.10 Syslog support
6.41.12.1.11 Obtain configuration file from a centralized server

6.42 Network Management System (NMS) Requirements

6.42.1 The IP/MPLS network shall provide a unified Network Management System for multiple network operators with different permission levels across multiple locations. Network management system should be a single integrated graphical user interface (GUI) product, capable of managing the full network solution from end to end.

6.42.1.1 The IP/MPLS network’s unified management system shall provide the following functionalities:

6.42.1.1.1 All IP/MPLS network devices shall be configurable by the NMS.
6.42.1.1.2 Support for multiple service types & revenue streams, including VPLS, H-VPLS, VLL, RFC2547 VPNs and Internet Access
6.42.1.1.3 Rapid service & revenue turn-up via end-to-end, point & click service provisioning
6.42.1.1.4 GUI-based user interface with pre-defined templates
6.42.1.1.5 Ability to provide information to existing network management applications
6.42.1.1.6 Carrier-class resiliency and synchronization between the NMS database and the nodes under management
6.42.1.1.7 Fault, Configuration, Accounting, Performance, Security (FCAPS) support
6.42.1.1.8 SNMP v3 support
6.42.1.1.9 Automatic discovery of network elements
6.42.1.1.10 Tools for measuring performance metrics of individual services
6.42.1.1.11 “Point and click” automatic report generation for circuit utilization accounting
6.42.1.1.12 Automate network performance tests and alert, if certain performance thresholds are not met
6.42.1.1.13 Unified Network Management System for multiple network operators with different permission levels across multiple locations
6.42.1.1.14 Automatic provisioning on new IP/MPLS network devices added to the system
6.42.1.1.15 Configuration backup support
6.43 Microwave and MPLS Statement of Work

6.43.1 The Proposer shall be responsible for providing a complete and functional licensed 6 GHz / 11 GHz digital microwave transport and MPLS switching system, with full system design, implementation, testing and optimization encompassing the following subsystems:

6.43.2 The Proposer shall be responsible for providing the following project components and services:

6.43.2.1 Engineering and System Design
6.43.2.2 Furnishing and installing all microwave system equipment and ancillary systems, including temporary facilities as needed for system transition
6.43.2.3 Project Management
6.43.2.4 Software and firmware installation and programming
6.43.2.5 Technical training
6.43.2.6 Factory acceptance testing
6.43.2.7 Migration and transition planning and execution
6.43.2.8 All Installation
6.43.2.9 Microwave Radio and MPLS Switch Configuration, Programming and Testing
6.43.2.10 Field acceptance testing, including full test of microwave and MPLS equipment to manufacturer specifications
6.43.2.11 Warranty and Post Warranty Support Services

6.44 Microwave and MPLS Project Implementation Approach

6.44.1 Proposers shall follow an implementation approach that includes the following key activities:

6.44.1.1 Project Initiation through Notice To Proceed (NTP) and Kickoff Meeting
6.44.1.2 Design Review conducted in two phases:
6.44.1.3 Fixed infrastructure design effort conducted pre-contract
6.44.1.4 Final Design Review conducted post contract
6.44.1.5 Order Processing and Manufacturing
6.44.1.6 Factory Configuration (Staging)
6.44.1.7 Factory Acceptance Testing
6.44.1.8 Equipment Installation
6.44.1.9 Systems Integration and Optimization
6.44.1.10 Field Acceptance Testing
6.44.1.11 Technical and Operational Training
6.44.1.12 System Cutover
6.45 Microwave and MPLS Project Activities

6.45.1 The following defines, in detail, the expected project activities for the planning, design, manufacture, installation, optimization and testing of the PSERN.

6.45.2 Project Initiation - Proposer Project Manager shall initiate the implementation process. Proposer shall conduct the project initiation meeting(s) with Owner representatives to execute the following activities:

6.45.2.1 Introduction of the Proposer and Owner Project Managers as the single point of contact with authority to make routine project decisions

6.45.2.2 Introduction of all project team participants

6.45.2.3 Review of the roles of the project participants to identify communication flow and decision-making authority between participants

6.45.2.4 Review of the overall project scope and objectives

6.45.2.5 Review of the resource and scheduling requirements.

6.45.2.6 Review the draft project schedule addressing milestones and key deliverables

6.45.2.7 Review of the Project Management Plan and processes

6.45.3 Detailed Design Development and Review - After the kick off meeting, Proposer shall meet with Owner’s project team to achieve written agreement on the final microwave and MPLS system design, identify any special system or product requirements and their impact on system design or implementation, identify final microwave and MPLS system equipment counts and configurations, and refine the system implementation plan and plan documentation.

6.45.4 At the conclusion of the system design process, Proposer shall provide, at a minimum, the following documents to Owner for its review and approval:

6.45.4.1 Document Index

6.45.4.2 Project Schedule

6.45.4.3 Statement of Work

6.45.4.4 Microwave System Description

6.45.4.5 Microwave Network Map

6.45.4.6 Microwave Network Path Engineering Documentation

6.45.4.7 Path Calculations and Path Profiles

6.45.4.8 Microwave Path Survey Report with evidence of Field Validation of Paths

6.45.4.9 Frequency Plan

6.45.4.10 Frequency Coordination Submittals for FCC Part 101 Licensing

6.45.4.11 Equipment List including Antenna Systems
6.45.4.12 Site Rack Layout Drawings
6.45.4.13 Rack Elevation and Wiring Drawings
6.45.4.14 Antenna System Drawings
6.45.4.15 Tower Elevation / Antenna Placement Diagrams
6.45.4.16 System Block and Level Diagrams
6.45.4.17 IP Traffic Plan
6.45.4.18 DS1/DS3/OC3 Traffic Plan with DS0 Traffic Plan for existing and new circuits
6.45.4.19 Microwave Network Synchronization Plan
6.45.4.20 Microwave NMS Plan
6.45.4.21 MPLS NMS Plan
6.45.4.22 Site Alarm Definition
6.45.4.23 DC Power Consumption Data (based on measured values)
6.45.4.24 Site Heat Output Data (based on measured values)
6.45.4.25 Traffic Cutover Plan
6.45.4.26 Factory Acceptance Test Plan (FATP)
6.45.4.27 Equipment Inspections (100%)
6.45.4.28 Measured Values (sampled)
6.45.4.29 Functional Testing
6.45.4.30 Field Acceptance Test Plan (FATP)
6.45.4.31 Installed Equipment Inspections (100%)
6.45.4.32 Measure Values (100%)
6.45.4.33 Functional Testing
6.45.4.34 Training Plan
6.45.4.35 Transition Plan
6.45.4.36 Preventative Maintenance Plan
6.45.4.37 System administrator documentation and system programming parameters

6.45.5 **Owner Responsibilities** - during the system design period, the Owner shall:

6.45.5.1 Finalize site acquisition, zoning and permitting and customer responsibilities for site additions and site improvements

6.45.5.2 Provide a microwave site “ready” indication to Proposer by the date specified in the Project Schedule

6.45.5.3 This activity is complete when all documentation and detailed documents associated with this activity have been delivered to Owner, reviewed and approved by Owner, and signed by the designated representative from Owner. After acceptance of the microwave and MPLS design, Proposer shall schedule all factory orders for shipment
to meet the approved project schedule. Each of the specific design activities associated with developing these design documents is described in the following section. Some Detailed Design Development activities shall involve the review and finalization of multiple documents.

6.45.6 Finalize Project Schedule - The objective of this task is to finalize the preliminary Project Schedule contained in the Proposal and as amended in the Project Initiation meeting. This finalization shall be based on the requirements identified in the Detailed Design Development Review and shall take into consideration the project objectives, plans, schedules, activities, approvals, priorities and interdependencies among tasks.

6.45.6.1 The Project Schedule shall be finalized at the end of the Detailed Design Development and Review process and mutually agreed upon between the Parties. The resulting document defines the specific project tasks to be completed and verifies the final Project Schedule for each subsystem to be implemented.

6.45.6.2 The accepted Project Schedule shall become the governing Project Schedule incorporated into the contract, and is subject to change only upon agreement of Owner.

6.45.7 Finalize Statement of Work - Proposer shall provide in the Proposal a comprehensive Statement of Work meeting the requirements established by Owner. This Statement of Work shall serve as the baseline design. During the detailed design development process, Proposer and Owner shall work together to finalize the Statement of Work for the Owner radio system.

6.45.8 Finalize Microwave and MPLS Network System Design - Proposer shall provide in the Proposal a comprehensive microwave system design meeting the requirements established by Owner. This design shall serve as the baseline design. During the detailed design development process, Proposer and Owner shall work together to finalize the microwave system design for the Owner radio system.

6.45.8.1 Proposer shall consult with Owner to establish existing traffic requirements and circuiting technology presently being used, develop the IP/MPLS switch configuration and establish the NMS plans for both the microwave radio network and the MPLS switch network. Planning for both the bandwidth requirements of the P25 radio system and supporting systems, as well as future growth requirements shall be a part of this process.

6.45.8.2 Contractor shall inspect all existing antenna mounting structure description as required to design and supply all antenna mounting, waveguide attachments, entry ports/waveguide boots and microwave cable management systems. Contractor shall create site plan drawings with major landmarks shown, provide final path calculations and path profiles for each hop, identify locations of possible sources of spectral reflection or interference and identify the required antenna size, type and mounting height.

6.45.8.3 Design Activities shall include development of a final equipment lists, site specific drawings (including rack profiles and wiring diagrams), traffic plans, NMS plans, system synchronization plans, as well as DC power and HVAC requirements.
6.45.9 Design and Full Field Verification of Microwave Paths - Design activities shall include a design meeting a required path reliability of 99.999% at the required BER rates for support of the trunked radio system design.

6.45.9.1 As a part of this design activity, Proposer shall develop, explain and document all engineering assumptions and performance validation data for site links. This shall include software modeling for path engineering, review of map or topographic data used in the model, and all assumptions used in determining optimal path configuration.

6.45.9.2 Path design shall identify Fresnel zone clearances, fade margin and terrain path obstructions to include projected tree growth over the 20 year assumed lifetime of the PSERN. Contractor shall establish with Owner the path clearance objective for each path and shall as part of it’s field investigations establish accurate site elevation and coordinates for all facilities.

6.45.9.3 In addition to the required reliability and design using path design software, all paths shall be fully field verified through field surveys that examine tower space availability, near field obstructions and any mid-path obstacles. Results from any optical path verification surveys performed shall be incorporated into the final system design and design documentation.

6.45.10 Prepare Final Microwave Frequency Plan and FCC License Applications - Proposer shall prepare any necessary licensing documentation, including engineering documents if required, secure Owner signatures for all applications, and submit for microwave coordination.

6.45.10.1 Proposer shall have sole responsibility for preparing all applications, including any required engineering showings. Once local coordination is approved, applications shall be submitted to the FCC. All application and coordination costs shall be paid by Proposer.

6.45.11 Finalize Space, Power and HVAC Requirements - Proposer shall finalize space, power and HVAC requirements for Owner based on the agreed upon design.

6.45.11.1 Proposer shall provide floor layout and rack elevation drawings with associated transition plans for each site.

6.45.11.2 Proposer shall provide actual measured power consumption and heat output data rather than specification sheet data in order to comply with the requirements of this task. Prior to finalization of the space, power and HVAC requirements,

6.45.11.3 Proposer shall have completed the system design including defining the number of microwave sites and their location, the overall system configuration and architecture and must be in the configuration shall be jointly agreed upon by Owner and Proposer.

6.45.12 Finalize Cutover Plan - A preliminary cutover plan shall be provided as part of the Proposal. To ensure a smooth transition from the existing radio system to the new radio system, a detailed cutover plan shall be finalized during the Detailed Design Development and Review, to transition to the new radio system.

6.45.12.1 As the implementation proceeds, further detail shall be added by the Proposer to the cutover plan. Individual cutover plans shall be
developed for individual systems and sub-systems including microwave network equipment, as well as other systems.

6.45.13 **Finalize Acceptance Test Plan (ATP) Procedures** - Draft acceptance test plans shall be provided in the Proposal. Proposer and County shall finalize ATP documents in the Detailed Design Development and Review to provide the required procedures to be used for testing the functionality and performance of the system.

6.45.13.1 The ATP documents establish the sole framework for system acceptance. The tests shall validate the functional performance of the system. The ATP includes the acceptance criteria to ensure the equipment operates according to the specifications, design and standards identified in the Proposal.

6.45.14 **Site Preparation and Readiness** - As specified in the RFP, Proposer has designed the system to utilize the best selection of sites as specified in the RFP, while also adding facilities as required to meet the coverage requirements specified by Owner. Because site development responsibilities lie with both Proposer and with Owner, Proposer shall be flexible in working with the Owner to determine site readiness. For a site to be considered “ready,” it must have adequate room in an existing building or shelter to accommodate the equipment to be installed, along with electrical service and internal power distribution in place.

6.45.15 **Planning for Site Access** - Owner shall provide site access for scheduled site walks, installation, optimization, system troubleshooting and performance of acceptance testing for the duration of the project. Owner Project Manager and Proposer Project Managers shall coordinate and schedule access to each site when required. Owner shall use its best efforts to provide site access.

6.45.16 **Microwave Network Planning** - Proposer shall work with Owner to develop a comprehensive provisioning plan for the microwave transport and MPLS network overlay.

6.45.16.1 This work takes place during the Detailed Design Development activity and extends beyond its completion. Proposer shall conduct meetings with Owner to define microwave path channel assignments, circuit labeling/mapping, and discuss effective organization of QoS Label priorities, and detail how to set up IP routing tables throughout the system.

6.45.16.2 During system implementation, Proposer shall support and guide Owner in its efforts to define the fleet mapping and programming requirements. The microwave and MPLS infrastructure equipment in the system shall be configured based on this provisioning plan. Proposer shall include development of all programming templates for the microwave and MPLS equipment.

6.45.17 **Manufacturer Order Processing and System Manufacture** - After the Contract Design Review and subsequent contract execution, Proposer shall process orders for equipment and begin equipment manufacturing.
6.45.18 **Factory Staging** - Proposer shall provide factory staging for all major fixed-end equipment, including the microwave and MPLS networks and a representative sampling of subscriber units in the Proposal.

6.45.18.1 Proposer shall assemble the full system hardware at a single location. Physical setup, racking and location of hardware shall comply with Owner’s approved equipment layout plans. Cables shall be cut and labeled with information to clarify interconnection for field installation. Cables shall be cut to fit the room layout plan specifications. All provided inter-rack and inter-equipment cables shall have connectors attached and tested. No DC power systems shall be staged at the factory location.

6.45.18.2 After assembling the equipment, Proposer’s Staging Technicians and Field Activities Managers shall power up the equipment, load software, set levels, program, configure and optimize the equipment. System parameters shall be set according to inputs from the Proposer design team. System software and system features shall be tested and validated. All system levels shall be set according to specifications to verify proper end-to-end connectivity. These settings shall be recorded and documented to provide baseline information to the field integration team.

6.45.18.3 The system shall be exercised while in factory staging which shall allow testing and burn-in of components and boards for proper operation as a complete system prior to shipping to Owner. Once the system or subsystem has been assembled, optimized, and integrated as a complete working unit, the system shall be tested according to the Factory Acceptance Test procedures.

6.45.19 **Factory Acceptance Testing** - Upon satisfactory completion of tests, Proposer shall coordinate with Owner for a factory visit to participate in system testing. This visit shall provide Owner with the opportunity to see the microwave and MPLS equipment assembled and working as an integrated system and to test in a hands-on manner, most functionality and features of the communication system that are capable of operation in a factory environment. Factory acceptance testing shall comprise of three (3) elements. These are:

6.45.19.1 100% Inspection by Proposer and County of all staged fixed infrastructure

6.45.19.2 5% Selective measurement of all equipment levels, settings and input/output values by Proposer and review of all measured values by Owner. Measurements shall be witnessed

6.45.19.3 Functional testing of all features present in the Proposal and purchased by Owner as a joint activity between the Owner and Proposer.

6.45.20 At completion of system staging Factory Acceptance Testing, Proposer shall inventory the equipment. Proposer shall update the inventory database with this information to assist in tracking upon delivery to the field.

6.45.21 **Fixed Network Equipment Installation** - Proposer shall be responsible for warehousing and delivery of equipment to the sites. Proposer shall be responsible for all installation of proposer furnished equipment and shall have responsibility for bolting the racks to the floor, providing earthquake bracing, and ensuring that all
equipment is properly secured. All equipment shall be installed in a neat and professional manner, employing a standard of workmanship consistent with the Proposal and specifications and standards referenced in the RFP.

6.45.21.1 Infrastructure and antenna systems shall be installed per quantities and at locations identified in the Proposal, and subsequent Owner approved design changes. Proposer shall cable the equipment and furnish and install microwave antenna systems and provide any required cable management materials including entry boots, tower cable boots or other cable management items, and all required antenna mounts. All microwave antennas shall be installed with two added struts between each antenna and the tower or mounting structure, wherever possible, to provide antenna stability. All antennas and antenna feed lines shall be swept for return loss and results reviewed with Owner.

6.45.21.2 For installation of the fixed equipment at the various sites, Proposer shall furnish all cables for power, audio, control, and microwave transmission to connect the supplied equipment to the power panels or receptacles and the audio/control line connection point. All cabling shall be cut to length, properly connected and terminated per Owner installation standards and clearly labeled at both ends. All associated punch block connections shall be properly labeled. All cabling, port assignments, and punch block connections shall be recorded into the final system as-built documentation.

6.45.21.3 Proposer shall ground and bond all provided equipment during installation and Proposer is responsible for connecting all equipment to the common ground system at the existing facilities. All cabinets, racks, enclosures, telephone circuit surge protectors, and transmission line surge protectors provided shall be connected to the single point ground. Proposer shall connect all ground connections using approved non-reversible crimp or clamp connections.

6.45.21.4 During field installation of the equipment, any required changes to the installation shall be noted and assembled with the final as-built documentation of the system. The as-built documents shall be provided at the end of the project along with the maintenance and operator manuals. Upon completion of installation, Proposer shall perform final site inspections to verify proper physical installation and operational configurations of each individual site.

6.45.21.5 Proposer is responsible to provide, install, optimize and test the new microwave network and MPLS network equipment to enable the proper functioning of the P25 trunked system, as well as legacy circuits.

6.45.21.6 Proposer shall remove and dispose of decommissioned equipment associated with the existing Owner trunked radio.

6.45.22 System Optimization - Proposer shall verify that all equipment is operating properly and that all levels are properly set once installation in the field is complete.

6.45.22.1 Proposer shall optimize each subsystem individually. All audio and data levels shall be checked to verify factory settings.
6.45.22.2 All equipment shall have power output and RSL checked by Proposer after connection to the antenna systems to verify that they meet the FCC requirements and are within Proposer design tolerances. All communication interfaces between devices shall be verified for proper operation.

6.45.22.3 All features and functionality shall be tested by Proposer to ensure that they are functioning according to the manufacturer’s specifications and per the final configuration established during system staging.

6.45.23 System Technical Training - Technical training shall be provided for technical personnel per the training courses identified in the Proposal.

6.45.23.1 Training shall take place at the microwave and MPLS manufacturer facilities and/or at various locations within King County. The optimum timing of when training takes place shall be established by the Proposer.

6.45.23.2 Proposer shall conduct their training courses to thoroughly train Owner technical personnel on operation and support of the system.

6.45.24 Field Acceptance Tests - Field acceptance testing shall comprise of three (3) elements. These are:

6.45.24.1 100% Inspection by Proposer and County of all installed fixed infrastructure

6.45.24.2 100% Measurement of all equipment levels, settings and input/output values by Proposer and review of all measured values by Owner. Some measurements shall be witnessed by Owner’s representative technical staff.

6.45.24.3 Functional testing of all features present in the Proposal and purchased by Owner as a joint activity between the Owner and Proposer.

6.45.25 System acceptance tests shall be performed when the system optimization is complete. The field acceptance tests verify the full system functionality. These tests shall verify the entire system in operation, including radio system roaming and subscriber affiliation.

6.45.26 Operational Test - The installed system shall be operational without significant flaw or defect as defined in Part B of the RFP, prior to system acceptance for a minimum of sixty (60) consecutive calendar days in order for the system to be ready for user agency transition.

6.45.26.1 Radio traffic shall be generated by system testers and through use of patches to existing radio systems.

6.45.26.2 System operation shall be closely monitored for this period. Significant flaws or defects shall require resolution by Proposer. Failures between the fifty-sixth (56th) and sixtieth (60th) day shall add fifteen (15) days to the operational test period. Failure on or before the fifty-fifth (55th) day shall restart the full thirty (30) day test interval.
6.45.27 Cutover to New System Operations - The existing Owner regional radio system and existing microwave network shall need to remain functional to the greatest extent possible through system transition without significant loss of dispatch and radio user communications capability.

6.45.27.1 Existing microwave system connectivity shall either be fully supported on the new microwave and MPLS system or alternatively, the legacy microwave network shall remain fully functional until such time as the new P25 radio system has begun full and stable operation and been accepted by Owner.

6.45.27.2 Proposers shall develop a comprehensive series of Cutover Plans that demonstrate their strategy for transitioning the existing Owner microwave system to the new network. Proposers are cautioned that transitions that include the reuse of existing microwave licenses must detail the methodology to be used for the transition process in the Proposal.

6.45.27.3 The Cutover Plans shall be finalized working directly with Owner’s Project Managers. The mutually agreed upon methodology for cutover shall ensure that a safe, effective and efficient transition occurs from the old microwave network to the new network with minimum impact on user operations.

6.45.27.4 The Cutover Plan shall detail timelines, sequence of events, resources involved, potential downtime, operational details, which circuits move to the new system, and the order in which they will migrate.

6.45.27.5 A Cutover Plan timetable listing the chronological orders and time frames shall be developed. The Cutover Plan shall consider, as a minimum, the following components:

6.45.27.5.1 Site equipment and RF system cutover (spectrum management, and tower and equipment space considerations)

6.45.27.5.2 Site power-management strategy (managing peak loads with both systems active)

6.45.27.5.3 Circuit level cutover

6.45.27.5.4 Site "turn up" sequencing

6.45.27.5.5 Other considerations not specifically included above

6.45.27.5.6 Work outside of normal hours (incl. late nights and weekends) when system traffic is non-peak.

6.45.27.5.7 Define any periods of expected outages

6.45.27.5.8 Define any expected risks to operations (potential service interruptions) based on the transition plan

6.45.27.6 The use of Gantt chart or flowcharts to represent activities and sequencing of a transition strategy is requested.

6.45.27.7 Proposer shall include a fall back plan should there be a need to abort the cutover and restore Owner’s operations to the legacy radio system.
6.45.28 **System Acceptance** - Refer to the definition language of System Acceptance located in Part B.

6.45.29 **Disposal of Dismantled Microwave Radio System** - Owner wishes to recover the removed microwave network components, as well as other ancillary equipment removed as part of the system upgrade and replacement.

6.45.29.1 The Proposer shall be responsible for the removal, inventorying, staging, packaging (by boxing, palletizing and wrapping) and delivery of all removed components to a staging and storage area to be determined by Owner project staff.

6.45.29.2 Every effort shall be made by the contractor team to carefully remove all components so as to not incur damage or destruction in the removal process. Additionally, to thwart potential job-site theft and vandalism, the contractor shall ensure that removed equipment is stored and secured.

6.45.30 **Project Finalization** - Proposer shall work with Owner to resolve punch-list items documented during system installation and testing in order to meet all criteria for final system acceptance.

6.45.30.1 Owner shall approve resolution of all punch list items.

6.45.30.2 Any required FCC notifications of construction completion shall also be the responsibility of Proposer.

6.45.31 **System Design Documentation** - Proposer shall provide documentation of the system configurations, physical installation, and system testing. Documentation shall be created and updated during the project.

6.45.31.1 Documentation shall be provided as both printed copies, in sufficient quantities to meet County requirements, and as PDF documents.

6.45.31.2 Documentation shall be provided in County maintainable formats (MS Office, Visio, AutoCAD or other formats) or PDF’s where the provided documentation depends on Proposer-proprietary formats.

6.45.31.3 Electronic versions of Proposer-proprietary formats shall be provided both in a viewable format and in the document’s standard format.

6.45.32 **Factory Staging Documentation** - Proposer shall create or update the following documents at the conclusion of system staging:

6.45.32.1 Microwave radio and MPLS programming templates

6.45.32.2 Interconnection drawings

6.45.32.3 Manufacturer’s standard operator manuals

6.45.32.4 Re-assembly instructions

6.45.32.5 Interconnection cable description and inventory

6.45.32.6 Printout of equipment parameters

6.45.32.7 Inventory with serial numbers and installation reference

6.45.32.8 Software/firmware version numbers

6.45.32.9 Manufacturer’s standard technical manuals
6.45.33 As-Built System Documentation - Proposer shall supply as-built documentation for all supplied systems.

6.45.33.1 Documentation shall be provided as both printed copies and as PDF documents. Documentation shall be provided in Owner maintainable native formats (MS Office, Visio, AutoCAD or other formats) or PDF’s where the provided documentation depends on Proposer-proprietary formats.

6.45.33.2 One (1) full copy of each site’s system as-built drawing set shall be left at each site along with a copy of all applicable equipment and system manuals as a permanent reference. Thirty (30) master system as-built documentation sets and copies of all applicable equipment and system manuals shall be provided for central retention, along with softcopies of all documents in both their native formats and as PDF’s.

6.45.33.3 A final, fully integrated as-built drawing set shall be provided 90 days following completion of the project and prior to issuance of final payment.

6.45.34 The documentation shall, at a minimum, consist of:

6.45.34.1 Standard Equipment Manuals
6.45.34.2 System drawings:
6.45.34.3 Fixed Equipment Documentation
6.45.34.4 Plan and elevation views of the equipment installation at the radio site
6.45.34.5 Equipment inter-cabling diagrams for each site
6.45.34.6 Demarcation wiring lists
6.45.34.7 Programming and level setting data sheets
6.45.34.8 Equipment by site
6.45.34.9 Key Access Procedures
6.45.34.10 Site Inventory Lists
6.45.34.11 Remote sign-on procedures and passwords
6.45.34.12 Software versions and equipment wiring by equipment site
6.45.34.13 Microwave Licenses and Construction Completion Notices to FCC
6.45.34.14 Field ATP test sheets and results
6.45.34.15 Preventative Maintenance Plan
6.45.34.16 System Administrator Documentation
6.45.34.17 System Programming Parameters
6.45.34.18 Maintenance Records
6.45.34.19 Warranty information
6.45.34.20 Service Provider
7 SITE DC POWER SYSTEMS

7.1 Technical Introduction

7.1.1 The Owner desires to use 100% Direct Current (DC) within wireless communications facilities to power radio and other critical site equipment. Modern radio communications equipment, especially current P25 Phase II (TDMA) base stations, often utilize -48 Volt DC for power, while other equipment utilizes positive 24 Volt DC or 12 Volt DC. In addition, wireless facilities almost always have some equipment that requires Alternating Current (AC). For equipment not permitting direct DC power input, the requirement is to have 120 VAC provided via inverters, thus maintaining 100% “float” on the site -48 VDC system.

7.1.2 In the event of a commercial power failure, wireless communications facilities are expected to remain fully operational. This expectation necessitates an emergency power design strategy that includes some level of battery backup. Running a site on DC Power with battery backup is the most efficient way to provide continuous power during the period of time between commercial power fail and when power can be restored or when an alternative source of power can be supplies such as a generator. It also reduces the power transients that potentially occur in other systems not “floated” on DC batteries during the small but critical milliseconds to seconds as standby power systems transfer and come on line.

7.1.3 Mission-Critical First Responder Communications facilities need to have power systems designed to accommodate all of these power needs while considering the future power needs and inevitable expansion of the power systems.

7.2 Site DC Power System Specifications

7.2.1 Rectifiers (-48 VDC) - Rectifiers shall provide managed charging current and battery voltage monitoring for following conditions in accordance with the recommendations of the manufacturer of batteries supplied as part of the system. Additional Rectifier required features include:

7.2.1.1 Temperature compensation feature circuitry for ambient and cell temperature

7.2.1.2 Float charging to maintain fully charged batteries for maximum lifetime

7.2.1.3 Maximum-lifetime charge rate for replenishing batteries from moderate discharge

7.2.1.4 Maximum-rate charge for re-charging after near or complete depletion of charge

7.2.1.5 Rectifiers proposed shall be configured for an N+1 configuration, with load sharing between each rectifier

7.2.1.6 Rectifiers shall be sized to be capable of restoring a fully discharged

7.2.1.7 Bring battery plant to a fully charged condition in eight (8) hours or less while maintaining full normal facility load

7.2.2 DC Distribution - The proposed system shall be equipped with a battery voltage distribution terminal for connection to loads and shall be installed to allow:

7.2.2.1 A minimum of 12 circuit breaker positions to accommodate circuit breakers 5A to 100 capacity

7.2.2.2 Clear labeling of each circuit associated with each breaker
7.2.2.3 Addition or replacement of circuit breakers with voltage applied to buss without danger of arc-over

7.2.2.4 Ability to route new circuit feeder wires into distribution panel with voltage applied, without danger of arc-over

7.2.3 DC Plant System Monitoring - The rectifier/distribution installation shall provide continuous monitoring of voltage, charge, and discharge rates both on visual meters and electronically via a connected Ethernet / SNMP channel.

7.2.3.1 The installation of the battery/rectifier/distribution system shall include the operational connection of the SNMP remote monitoring and alarming capability.

7.2.4 DC Output Ripple and Line Regulation - The proposed rectifiers shall be fully filtered and provide a clean DC output under designed load with the following ripple voltage and line regulation performance specifications:

7.2.4.1 Ripple and Noise – 20 mV rms typical (10 kHz to 20 MHz), 32 dBmC (without attached battery)

7.2.4.2 Regulation - +/- 1% over line, load, and temperature

7.2.5 -48 VDC to +24 VDC DC – DC Converter - The proposed -48 VDC to +24 V DC/DC Converter shall be equipped with following features:

7.2.5.1 Separate power switch and primary overload protection

7.2.5.2 Continuous voltage and current monitoring, both meter and SNMP

7.2.5.3 Multiple load connections each with appropriate circuit breaker

7.2.6 -48 VDC to +12 VDC DC – DC Converter - The proposed -48 VDC to +12 V DC/DC Converter shall be equipped with following features:

7.2.6.1 Separate power switch and primary overload protection

7.2.6.2 Continuous voltage and current monitoring, both meter and SNMP

7.2.6.3 Multiple load connections each with appropriate circuit breaker

7.2.7 -48 VDC to 120 VAC Inverters - The proposed -48 VDC to 120 VAC Inverter shall be equipped with following features:

7.2.7.1 Pure sine wave output

7.2.7.2 Separate power switch and primary overload protection

7.2.7.3 Continuous voltage and current monitoring, both meter and SNMP

7.2.7.4 Multiple load connections each with appropriate circuit breaker

7.2.7.5 The AC inverter may be rack mounted with other power equipment, or free standing, bolted to floor, with separate 120VAC power distribution breaker panel

7.2.8 -48 VDC Battery Plant - The proposed -48 VDC battery plant shall be designed to meet the run time requirements based upon its location and accessibility.

7.2.9 The Proposer shall design battery plant run times for twelve (12) hours of continuous operation of all related site loads and equipment to include microwave. This run time shall apply to all existing and future PSERN sites located above 2000' AGL.
7.2.10 The Proposer shall design battery plant run times for eight (8) hours of continuous operation of all related site loads and equipment to include microwave. This run time shall apply to all existing and future PSERN sites located below 2000’ AGL.

7.2.11 Battery Cell Chemistry - The battery plant shall utilize long-life sealed-type lead acid type cells. The battery bank shall not require the use of spill containment arrangements and should be compatible with a closed environment.

7.2.12 Low Voltage Disconnect Device - The DC Power system design shall utilize low voltage disconnect in series on its main output to protect facility equipment from an under-voltage condition during the latter stages of Battery Plant discharge.

7.2.13 The low voltage disconnect shall be selected for the expected voltage and current load and shall have a user-configurable “trip point” or disconnect voltage level.

7.2.14 Adequate Load Size of DC Power System - The battery charger, inverter, and converter systems shall be sized to support the proposed PSERN equipment plus an additional 50% load. The battery system itself shall be of sufficient capacity to provide twelve (12) hour run-times at all site above 1250’ AGL and eight (8) hours at all other sites.

7.2.15 Battery Cell Useful Lifetime - Proposals shall offer battery models with a manufacturer’s estimated lifetime of twenty (20) years under normal usage.

7.2.16 Design Availability - Proposers shall provide battery system designs that avoid any single point of failure that would prevent delivery of primary DC and AC currents required to operate each site.

7.2.17 Battery Bypass - All battery systems proposed shall include the ability to safely bypass the battery stack, without manual disconnection of cabling, in order to provide continued operation of the site from the attached rectifiers, while facilitating load testing of the batteries.

7.2.18 Physical and Safety Requirements - The proposed DC battery plant shall take into consideration space requirements, floor weight loading limitations, cell ventilation requirements and hazardous materials and other applicable OSHA and MSDA requirements. Subsystems and components needed for proper battery plant installation, operation and maintenance shall be detailed accordingly.

7.2.19 Battery Mounts - Batteries shall be mounted on battery racks or elevated platforms located in equipment rooms such as to allow ventilation and cleaning without moving racks.

7.2.20 Seismic Considerations - Battery racks shall be designed to meet current UBC requirements for seismic stability based on the earthquake hazard level identified for the King County region. Batteries shall be secure against mounting disruption in event of earthquake, and protected against vulnerability to falling objects from surrounding racks or shelves. All cables and terminals shall be equipped with covers to prevent shorting or arcing from accidental contact.

7.2.21 Expandability - The Proposer shall design and offer a DC Power System scalable architecture that shall allow for future increase in load requirements. Examples of this include modular design for adding additional rectifier units, battery racks allowing vertical or horizontal expansion to permit additional cells, etc.

7.2.22 Design shall accommodate a 50% increase in -48 VDC rectifier capacity from initial load requirements.
7.2.23 Design shall accommodate a 50% increase in -48 VDC to 120 VAC inverter capacity

7.2.24 Additional Requirements - The proposed solution shall permit Interface to System Diagnostics (IP, Provide SNMP traps).

7.3 DC Power Systems Statement of Work

7.3.1 The Proposer shall be responsible for providing a complete and functional DC Power system at all of the facilities as required by their design, with full system design, implementation and optimization.

7.3.2 The Proposer shall be responsible for providing the following project components and services:

7.3.2.1 Engineering and DC Power System Design
7.3.2.2 Project Management
7.3.2.3 Furnishing and installing all DC Power System equipment and ancillary systems, including temporary facilities as needed for system transition
7.3.2.4 -48 VDC Battery Plant installation
7.3.2.5 -48 VDC Rectifier installation and configuration
7.3.2.6 DC – DC Converter installation and configuration
7.3.2.7 -48 VDC – 120 VAC Inverter installation and configuration
7.3.2.8 All rack, cabinets and trays for DC Power system components
7.3.2.9 Training
7.3.2.10 Acceptance testing
7.3.2.11 Migration and transition plan and execution
7.3.2.12 Warranty and Post Warranty Support Services
7.3.2.13 Full test of DC Power System equipment to manufacturer specifications (test plan shall be developed and submitted for Owner approval)

7.4 DC Power System Project Implementation Approach

7.4.1 Proposers shall follow an implementation approach that includes the following key phases:

7.4.1.1 Project Initiation through Notice To Proceed (NTP) and Kickoff Meeting
7.4.1.2 Design Review conducted in two phases:
7.4.1.3 DC Power System design effort conducted pre-contract
7.4.1.4 Final Design Review conducted post contract
7.4.1.5 Order Processing and Manufacturing
7.4.1.6 Equipment Installation
7.4.1.7 Equipment Integration and Optimization
7.4.1.8 Field Acceptance Testing
7.4.1.9 Technical and Operational Training
7.4.1.10 System Cutover
7.4.1.11 Project Finalization
7.4.1.12 Warranty Support
7.4.1.13 Post Warranty Support Period

7.5 DC Power System Project Activities

7.5.1 The following defines, in detail, the expected project phases for the planning, design, manufacture, installation, optimization and testing of the DC Power system.

7.5.2 Project Initiation - Proposer Project Manager shall initiate the implementation process. Proposer shall conduct the project initiation meeting(s) with Owner representatives to include the following activities:

7.5.2.1 Introduction of the Proposer and Owner Project Managers as the single point of contact with authority to make routine project decisions
7.5.2.2 Introduction of all DC Power System project team participants
7.5.2.3 Review of the roles of the project participants to identify communication flow and decision-making authority between participants
7.5.2.4 Review of the overall DC Power System project scope and objectives
7.5.2.5 Review of the resource and scheduling requirements.
7.5.2.6 Review the draft project schedule addressing milestones and key deliverables
7.5.2.7 Review of the Project Management Plan and processes

7.5.3 This task is considered complete when the Project Kickoff Session has been held with Proposer and Owner representatives in attendance, and when project scope, schedules, procedures, roles and responsibilities have been documented and agreed upon.

7.5.4 Detailed Design Development and Review - After the kick off meeting, Proposer shall meet with Owner’s project team to achieve written agreement on the final DC Power System design, identify any special system or product requirements and their impact on design or implementation, and refine the DC Power System implementation plan and plan documentation.

7.5.5 Proposer shall provide, at a minimum, the following documents to Owner for its review and approval:

7.5.5.1 Document Index
7.5.5.2 Project Schedule
7.5.5.3 Statement of Work
7.5.5.4 DC Power System Description
7.5.5.5 Site Layout Drawings
7.5.5.6 Shelter Floor Plan Drawings
7.5.5.7 Shelter Floor (weight) Loading Calculations
7.5.5.8 Rack Elevation Drawings
7.5.5.9 System Block and Level Diagrams
7.5.6 **Owner Responsibilities** - During this period, the Owner shall:

7.5.6.1 Provide access to all facilities for DC Power System implementation

7.5.6.2 Provide contact information for all Owner technical personnel supporting this phase of the project.

7.5.7 This activity is complete when all documentation and detailed documents associated with the DC Power System phase have been delivered to Owner, reviewed and approved by Owner, and signed by the designated representative from Owner. After acceptance, Proposer shall schedule all factory orders for shipment to meet the approved project schedule. Each of the specific design activities associated with developing these design documents is described in the following section. Some Detailed Design Development activities shall involve the review and finalization of multiple documents.

7.5.8 **Finalize DC Power Systems Project Schedule** - The objective of this task is to finalize the preliminary Project Schedule contained in the Proposal and as amended in the Project Initiation meeting. This finalization shall be based on the requirements identified in the Detailed Design Development Review and shall take into consideration the project objectives, plans, schedules, activities, approvals, priorities and interdependencies among tasks.

7.5.9 The Project Schedule shall be finalized at the end of the Detailed Design Development and Review process and mutually agreed upon between the Parties. The resulting document defines the specific project tasks to be completed and verifies the final Project Schedule for each subsystem to be implemented.

7.5.10 The accepted DC Power System Project Schedule shall become the governing DC Power System Project Schedule incorporated into the contract, and is subject to change only upon mutual agreement of Proposer and Owner. The acceptance of the project schedule shall be the final activity of Detailed Design Development and Review process.

7.5.11 **Finalize Statement of Work** - Proposer has provided in the Proposal a comprehensive Statement of Work meeting the requirements established by Owner. This Statement of Work shall serve as the baseline design. During the
detailed design development process, Proposer and Owner shall work together to finalize the Statement of Work for the DC Power system.

7.5.12 Finalize DC Power System Design - Proposer has provided in the Proposal a comprehensive DC Power System design meeting the requirements established by Owner. This design shall serve as the baseline design. During the detailed design development process, Proposer and Owner shall work together to finalize the DC Power System design for the Owner radio system.

7.5.13 Finalize Space, Power and HVAC Requirements - Proposer shall finalize space, power and HVAC requirements for Owner based on the agreed upon design.

7.5.13.1 Proposer shall provide floor layout and rack elevation drawings with associated transition plans for each site. Proposer shall provide actual measured power consumption and heat output data rather than specification sheet data in order to comply with the requirements of this task. Prior to finalization of the space, power and HVAC requirements,

7.5.13.2 Proposer shall have completed the DC Power System design including defining the number of systems and their location, the DC Power System configuration at each site, the overall DC Power System configuration and architecture and the configuration shall be jointly agreed upon by Owner and Proposer.

7.5.14 Finalize Cutover Plan - A preliminary cutover plan has been provided as part of the Proposal. To ensure a smooth transition from the existing DC Power System to the new DC Power System, a detailed cutover plan shall be finalized during the Detailed Design Development and Review, to transition to the new radio system.

7.5.14.1 As the implementation proceeds, further detail shall be added by Proposer to the cutover plan. Individual cutover plans shall be developed for each DC Power System.

7.5.15 Finalize Acceptance Test Plan (ATP) Procedures - Draft acceptance test plans shall be provided in the Proposal. Proposer and County shall finalize ATP documents in the Detailed Design Development and Review to provide the required procedures to be used for testing the functionality and performance of the DC Power System.

7.5.15.1 The ATP documents establish the sole framework for system acceptance. The tests shall validate the functional performance of the system. The ATP includes the acceptance criteria to ensure the equipment operates according to the specifications, design and standards identified in the Proposal.

7.5.16 Planning for Site Access - Owner shall provide site access for scheduled site walks, installation, optimization, system troubleshooting and performance of acceptance testing for the duration of the project. Owner Project Manager and Proposer Project Managers shall coordinate and schedule access to each site when required. Owner shall use its best efforts to provide site access.

7.5.17 DC Power System Order Processing and System Manufacture - After the Contract Design Review and subsequent contract execution, Proposer shall process orders for DC Power System equipment and begin equipment procurement.

7.5.18 DC Power System Field Equipment Installation and Testing - Proposer shall be responsible for warehousing and delivery of DC Power System equipment to the
sites. Proposer shall be responsible for all installation of proposer furnished equipment and shall have responsibility for bolting the racks to the floor, providing earthquake bracing, and ensuring that all equipment is properly secured. All equipment shall be installed in a neat and professional manner, employing a standard of workmanship consistent with the Proposal and specifications and standards referenced in the RFP.

7.5.19 DC Power System components shall be installed per quantities and at locations identified in the Proposal, and subsequent Owner approved design changes. Proposer shall cable the equipment and provide any required cable management materials.

7.5.20 Proposer shall connect the DC power to the AC power panel provided by Owner. Proposer shall perform startup services on the DC power equipment.

7.5.21 Proposer shall furnish all cables for power and control to connect the supplied equipment to the power panels or receptacles and the control line connection point. All cabling shall be cut to length, properly connected and terminated per Owner installation standards and clearly labeled at both ends.

7.5.22 Proposer shall ground and bond all provided equipment during installation and Proposer is responsible for connecting all equipment to the common ground system at the existing facilities. All cabinets, racks, enclosures, circuit surge protectors provided shall be connected to the single point ground. Proposer shall connect all ground connections using approved non-reversible crimp or clamp connections.

7.5.23 During field installation of the DC Power System equipment, any required changes to the installation shall be noted and assembled with the final as-built documentation of the system. The as-built documents shall be provided at the end of the project along with the maintenance and operator manuals. Upon completion of installation, Proposer shall perform final site inspections to verify proper physical installation and operational configurations of each individual site.

7.5.24 Proposer shall remove and dispose of decommissioned equipment associated with the existing Proposer trunked radio.

7.5.25 DC Power System Optimization - Proposer shall verify that all DC Power System equipment is operating properly and that all voltages are properly set once installation in the field is complete.

7.5.26 Proposer shall optimize each subsystem individually. All voltage and current levels shall be checked to verify factory settings. All features and functionality shall be tested by Proposer to ensure that they are functioning according to the manufacturer’s specifications and per the final configuration established during system staging.

7.5.27 DC Power System Technical Training – Technical training shall be provided for technical personnel per the selected training courses identified in the Proposal.

7.5.28 Training shall take place at various locations within King County. The optimum timing of when training takes place shall be established by the Proposer.

7.5.29 Proposer shall conduct their training courses to thoroughly train Owner technical personnel on operation and support of the DC Power System.
7.5.30 **Field Acceptance Tests** - Field Acceptance testing shall comprise of five (5) elements. These are:

7.5.30.1 100% Inspection by Proposer and County of all installed DC Power System infrastructure

7.5.30.2 100% measurement of all equipment voltage and current settings by the Proposer, and review of all measured values by Owner.

7.5.30.3 Perform load test at all sites to observe and verify DC plant operational design.

7.5.30.4 Perform low-voltage test at one site to verify proper low-voltage disconnect operation.

7.5.30.5 Witnessed functional testing of all features present in the Proposal and purchased system.

7.5.31 System acceptance tests shall be performed when the DC Power System optimization is complete. The field acceptance tests verify the full DC Power System functionality in operation.

7.5.32 **Operational Test** - The installed DC Power System shall be operational with no failures for a minimum of sixty (60) consecutive calendar days in order for the DC Power System to be ready for user agency transition.

7.5.32.1 System operation shall be closely monitored for this period. Significant flaws or defects shall require resolution by Proposer. Failures between the fifty-sixth (56th) and sixtieth (60th) day shall add fifteen (15) days to the operational test period. Failure on or before the fifty-fifth (55th) day shall restart the full sixty (60) day test interval.

7.5.33 **Disposal of Dismantled DC Power Systems** - The Proposer shall be responsible for the removal and disposal of decommissioned DC Power System components, including disposal of hazardous waste from removed battery cells according to EPA and State of Washington guidelines as part of the system upgrade and replacement.

7.5.33.1 Every effort shall be made by the contractor team to carefully remove all components so as to not incur damage, destruction or creation of a hazardous waste event in the removal process. Additionally, to thwart potential job-site theft and vandalism, the contractor shall ensure that removed equipment is stored and secured.

7.5.34 **Project Finalization** - Proposer shall work with Owner to resolve punch-list items documented during DC Power System installation and testing in order to meet all criteria for final system acceptance.

7.5.34.1 Owner must approve resolution of all punch list items.

7.5.35 **DC Power System Design Documentation** - Proposer provides documentation of the DC Power System configurations, physical installation, and system testing. Documentation is created and updated during the project.

7.5.35.1 Documentation shall be provided as both printed copies, in sufficient quantities to meet County requirements, and as PDF documents.
7.5.35.2 Documentation shall be provided in County maintainable formats (MS Office, Visio, AutoCAD or other formats) or PDF’s where the provided documentation depends on Proposer-proprietary formats.

7.5.35.3 Electronic versions of Proposer-proprietary formats shall be provided both in a viewable format and in the documents standard format.

7.5.36 **Site Staging Documentation** - Proposer shall create or update the following standard documents during the site staging phase for the DC Power Systems:

7.5.36.1 Document Index
7.5.36.2 Project Schedule
7.5.36.3 Statement of Work
7.5.36.4 DC Power System Description
7.5.36.5 Site Layout Drawings
7.5.36.6 Shelter Floor Plan Drawings
7.5.36.7 Shelter Floor load (weight) calculations
7.5.36.8 Rack Elevation Drawings
7.5.36.9 System Block and Level Diagrams
7.5.36.10 Power Consumption Data (based on measured values)
7.5.36.11 Site Alarm Definition
7.5.36.12 Equipment Lists
7.5.36.13 Field Acceptance Test Plan (FATP)
7.5.36.14 Installed Equipment Inspections (100%)
7.5.36.15 Measure Values (100%)
7.5.36.16 Functional Testing
7.5.36.17 Training Plan
7.5.36.18 Transition Plan
7.5.36.19 System administrator documentation and system programming parameters

7.5.37 **As-Built DC Power System Documentation** - Proposer shall supply as-built documentation for all supplied DC Power Systems.

7.5.37.1 Documentation shall be provided as both printed copies and as PDF documents.

7.5.37.2 Documentation shall be provided in Owner maintainable native formats (MS Office, Visio, AutoCAD or other formats) or PDF’s where the provided documentation depends on Proposer-proprietary formats.

7.5.37.3 One (1) full copy of each site’s DC Power System as-built drawing set shall be left at each site along with a copy of all applicable equipment and system manuals as a permanent reference. One (1) master system as-built documentation sets and copies of all applicable equipment and system manuals shall be provided for central retention, along with softcopies of all documents in both their native formats and as PDF’s.
7.5.37.4 A final, fully integrated as-built drawing set shall be provided 90 days following completion of the project and prior to issuance of final payment.

7.5.38 The documentation shall, at a minimum, include the following:

7.5.38.1 Standard Equipment Manuals
7.5.38.2 System Drawings
7.5.38.3 Plan and Elevation views of the equipment installation at the site
7.5.38.4 Equipment inter-cabling Diagrams for each site
7.5.38.5 Demarcation Wiring Lists
7.5.38.6 Programming and configuration setting data sheets
7.5.38.7 Equipment by site
7.5.38.8 Site Inventory lists
7.5.38.9 Field ATP test sheets and results
7.5.38.10 Maintenance Records
7.5.38.11 Warranty Information

7.5.39
8 SITE ALARM AND VIDEO SYSTEMS

8.1 Technical Introduction

8.1.1 The Owner desires the ability to monitor access to all facilities, and record video imagery to protect from theft and vandalism.

8.1.2 The Proposer shall propose an alarm processor and management interface to be installed across the PSERN. The solution shall manage all on-site alarms for processing into SNMP “traps” for reporting back to the proposed Network Management System.

8.1.3 The Proposer shall propose a digital video recording (DVR) and storage solution for archiving and retrieval of site or facility video information.

8.1.4 In the event of microwave transport failure, the proposed alarm system shall have the capability of reporting alarms via alternate means, such as:

8.1.4.1 PSTN or PABX network interface for auto-dial reporting
8.1.4.2 Alarming via E-mail or commercial wireless SMS text messaging is desirable but not required

8.2 Site Shelter Access

8.2.1 Physical site access shall require card key validated entry at each shelter door, and shall be also supplemented by a physical key override.

8.3 Alarm Closure Inputs

8.3.1 The proposed site alarm processor solution shall support a minimum of sixteen (16) Form “C” relay inputs and output that can process alarm input states of “normally open”, “normally-closed” or momentary-latched condition from monitored devices.

8.3.2 Shall provide standard telco 66-pair punch block with cover and labeling installed on site at location TBD by Owner.

8.4 Analog Level Inputs (Fuel, Temp, Battery Voltage/Charge Currents, Etc.)

8.4.1 The proposed site alarm processor solution shall support analog inputs that can process alarm inputs produced by a discrete DC voltage level of over the range of 0 – 5 VDC and DC current of 0 - 40 mA. The analog values may be set to indicate an alarm condition if they rise above or below prescribed values.

8.5 Video Image Transmission

8.5.1 For safety and security reasons the ability to have active video transmission and recording of external and internal radio site spaces is desirable. Proposer shall recommend and offer an IP-based streaming audio recording and transmission solution that can integrate into the Network Management System.

8.5.2 Video recordings shall support saving to media utilizing a common industry data format (ex., mpeg, .avi, etc.) for easy transfer and replay on commercial off the shelf equipment.

8.5.3 The solution shall have the capability to support:

8.5.3.1 Four (4) cameras per site
8.5.3.2 The central DVR system shall have ninety (90) days retention
8.5.3.3 Be operated manually via remote control or else activate based upon a predetermined sound level or threshold

8.5.3.4 Have manually or dynamically controlled video quality based upon link quality or inactivity

8.5.3.5 Have motion sensing capabilities for activation from idle to active state

8.6 Integration with Site IP Network

8.6.1 As stated earlier the goal is to use the new high-availability PSERN digital microwave system and IP network as the platform for SNMP based alarm reporting and audio/video streaming.

8.6.2 The Proposer shall offer a solution that is compatible with the proposed microwave and IP/MPLS network and one that offer bandwidth conservation as an inherent feature.

8.7 Alarm and Video Systems Statement of Work

8.7.1 The Proposer shall be responsible for providing a complete and functional Site Alarm Processor, Management Interface and Video Monitoring and Recording System, with full system design, implementation and optimization.

8.7.2 The Proposer shall be responsible for providing the following project components and services:

- 8.7.2.1 Furnishing and Install Site Alarm Process and Management Interface System
- 8.7.2.2 Furnish and Install Site Video Recording and Monitoring System
- 8.7.2.3 Acceptance Testing
- 8.7.2.4 Alarm Sensor Installation
- 8.7.2.5 Motion Sensor Installation
- 8.7.2.6 Video Camera Installation
- 8.7.2.7 Alarm System Configuration and Testing
- 8.7.2.8 Video System Configuration and Testing
- 8.7.2.9 Warranty and Post Warranty Support Services
- 8.7.2.10 Training
- 8.7.2.11 Full test of all equipment to manufacturer specifications

8.8 Alarm and Video System Project Implementation Approach

8.8.1 Proposers shall follow an implementation approach that includes the following key phases:

- 8.8.1.1 Project Initiation through Notice To Proceed (NTP) and Kickoff Meeting
- 8.8.1.2 Design Review conducted in two phases:
  - 8.8.1.3 Fixed infrastructure design effort conducted pre-contract
  - 8.8.1.4 Final Design Review conducted post contract
- 8.8.1.5 Order Processing and Manufacturing
- 8.8.1.6 Equipment Installation
8.8.1.7 Systems Integration and Optimization
8.8.1.8 Field Acceptance Testing
8.8.1.9 Technical and Operational Training
8.8.1.10 Project Finalization
8.8.1.11 Warranty Support
8.8.1.12 Post Warranty Support Period

8.8.2 Finalize Space and Power Requirements - Proposer shall finalize space and power requirements for Owner based on the agreed upon design.
8.8.2.1 Proposer shall provide floor layout and rack elevation drawings with associated transition plans for each site.
8.8.2.2 Proposer shall provide actual measured power consumption rather than specification sheet data in order to comply with the requirements of this task. Prior to finalization of the space, and power requirements, the Proposer shall have completed the system design including defining the number of sites and their location, the number and type of alarm sensors and video monitoring points at each site, the overall system configuration and architecture and must the configuration shall be jointly agreed upon by Owner and Proposer.

8.8.3 Finalize Acceptance Test Plan (ATP) Procedures - Draft acceptance test plans shall be provided in the Proposal. Proposer and County shall finalize ATP documents in the Detailed Design Development and Review to provide the required procedures to be used for testing the functionality and performance of the Site Alarm and Video system.
8.8.3.1 The ATP documents establish the sole framework for system acceptance. The tests shall validate the functional performance of the Site Alarm and Video system. The ATP includes the acceptance criteria to ensure the equipment operates according to the specifications, design and standards identified in the Proposal.

8.8.4 Planning for Site Access - Owner shall provide site access for scheduled site walks, installation, optimization, system troubleshooting and performance of acceptance testing for the duration of the project. Owner Project Manager and Proposer Project Managers shall coordinate and schedule access to each site when required. Owner shall use its best efforts to provide site access.

8.8.5 Manufacturer Order Processing and System Manufacture - After the Contract Design Review and subsequent contract execution, Proposer shall process orders for equipment and begin equipment procurement.

8.8.6 Site Alarm and Video Equipment Field Installation and Testing - Proposer shall be responsible for warehousing and delivery of equipment to the sites. Proposer shall be responsible for all installation of proposer furnished equipment and shall have responsibility for bolting the racks to the floor, providing earthquake bracing, and ensuring that all equipment is properly secured. All equipment shall be installed in a neat and professional manner, employing a standard of workmanship consistent with the Proposal and specifications and standards referenced in the RFP.
8.8.6.1 Alarm sensors and video camera shall be installed per quantities and at locations identified in the Proposal, and subsequent Owner approved
design changes. Proposer shall provide any required cable management materials and all required sensor and video camera mounts.

8.8.6.2 For installation of the Site Alarm and Video system equipment at the various sites, Proposer shall furnish all cables for power, audio, video, and control to connect the supplied equipment to the power panels or receptacles and the line connection points. All cabling shall be cut to length, properly connected and terminated per Owner installation standards and clearly labeled at both ends.

8.8.6.3 All associated punch block connections shall be properly labeled. All sensors, cameras, cabling, port assignments, and punch block connections shall be recorded into the final system as-built documentation.

8.8.6.4 Proposer shall ground and bond all provided equipment during installation and Proposer is responsible for connecting all equipment to the common ground system at the existing facilities. All cabinets, racks, enclosures, telephone circuit surge protectors, and transmission line surge protectors provided shall be connected to the single point ground. Proposer shall connect all ground connections using approved non-reversible crimp or clamp connections.

8.8.6.5 During field installation of the equipment, any required changes to the installation shall be noted and assembled with the final as-built documentation of the system. The as-built documents shall be provided at the end of the project along with the maintenance and operator manuals. Upon completion of installation, Proposer shall perform final site inspections to verify proper physical installation and operational configurations of each individual site.

8.8.7 Site Alarm and Video System Optimization - Proposer shall verify that all Site Alarm and Video equipment is operating properly and that all alarm activation (I/O) levels and states, as well as video camera frame rate and “pixel trip-wire” adjustments are properly set once installation in the field is complete.

8.8.7.1 Proposer shall optimize each subsystem individually. All audio, video and alarm sensor levels shall be checked to verify factory settings.

8.8.7.2 All features and functionality shall be tested by Proposer to ensure that they are functioning according to the manufacturer’s specifications.

8.8.8 System Technical Training – Technical training shall be provided for technical personnel, and other personnel identified by Owner per the selected training courses identified in the Proposal.

8.8.8.1 Training shall take place at various locations within King County. The optimum timing of when training takes place shall be established by the Proposer.

8.8.8.2 Proposer shall conduct their training courses to thoroughly train Owner technical personnel on operation and support of the Site Alarm, Key Card Access and Video system.
8.8.9 **Field Acceptance Tests** - Field acceptance testing shall comprise of three (3) elements. These are:

8.8.9.1 100% Inspection by Proposer and Owner of all installed fixed infrastructure

8.8.9.2 100% Measurement of all equipment levels, settings and input/output values by Proposer and review of all measured values by Owner. Some measurements shall be witnessed by Owner.

8.8.9.3 Functional testing of all features present in the Proposal and purchased by Owner as a joint activity between the Owner and Proposer.

8.8.10 System acceptance tests shall be performed when the Site Alarm and Video system optimization is complete. The field acceptance tests verify the full system functionality. These tests shall verify the entire system in operation.

8.8.11 **Operational Test** - The installed system must be operational with no failures for a minimum of sixty (60) consecutive calendar days in order for the system to be ready for user agency transition.

8.8.11.1 System operation shall be closely monitored for this period. Significant flaws or defects shall require resolution by Proposer. Failures between the fifty-sixth (56th) and sixtieth (60th) day shall add fifteen (15) days to the operational test period. Failure on or before the fifty-fifth (55th) day shall restart the full sixty (60) day test interval.

8.8.12 **Project Finalization** - Proposer shall work with Owner to resolve punch-list items documented during Site Alarm and Video system installation and testing in order to meet all criteria for final system acceptance.

8.8.12.1 Owner must approve resolution of all punch list items.

8.8.13 **System Design Documentation** - Proposer provides documentation of the Site Alarm and Video system configurations, physical installation, and system testing. Documentation is created and updated during the project.

8.8.13.1 Documentation shall be provided as both printed copies, in sufficient quantities to meet County requirements, and as PDF documents.

8.8.13.2 Documentation shall be provided in County maintainable formats (MS Office, Visio, AutoCAD or other formats) or PDF’s where the provided documentation depends on Proposer-proprietary formats.

8.8.13.3 Electronic versions of Proposer-proprietary formats shall be provided both in a viewable format and in the documents standard format.

8.8.14 **Site Installation Documentation** - Proposer shall create or update the following standard documents during the installation phase for both the Site Alarm and Video systems:

8.8.14.1 Document Index

8.8.14.2 Project Schedule

8.8.14.3 Statement of Work

8.8.14.4 Site Alarm System Description

8.8.14.5 Site Key Card Access System Description

8.8.14.6 Alarm System IP Network Plan
8.8.14.7 Video System Description
8.8.14.8 Video System IP Network Plan
8.8.14.9 Site Layout Drawings
8.8.14.10 Shelter Floor Plan Drawings
8.8.14.11 Rack Elevation Drawings
8.8.14.12 System Block and Level Diagrams
8.8.14.13 Site Alarm Definitions
8.8.14.14 Video Activation ("trip-wire") Definition
8.8.14.15 Video Frame Rate and required Network Bandwidth Definition
8.8.14.16 Equipment Lists
8.8.14.17 Field Acceptance Test Plan (FATP)
8.8.14.18 Installed Equipment Inspections (100%)
8.8.14.19 Measure Values (100%)
8.8.14.20 Functional Testing
8.8.14.21 Coverage Acceptance Test Plan (CATP)
8.8.14.22 Training Plan
8.8.14.23 System administrator documentation and system configuration parameters
9 TEST EQUIPMENT

9.1 Technical Introduction

9.1.1 The Owner Radio Shop faces the task of maintaining an ever-growing fleet of radio subscriber units implementing more complex digital technology with limited staff and resources. Exploiting capabilities to streamline this task utilizing the latest features in communications analyzer technology is highly desirable.

9.1.2 There are three self-servicing entities within the PSERN operating environment that require infrastructure test equipment. These are City of Seattle, King County and Valley Communications. Owner provides technical support for radio system elements to Valley Comm. As a result, RF system test equipment is required by City of Seattle and King County. Proposer shall identify the recommended quantities of each type of test equipment identified in this Section. If additional test equipment not described in this Section is essential or useful to proposer system support, Proposal shall describe that equipment and provide unit pricing.

9.2 P25 Communications Analyzers (Qty. 15)

9.2.1 The Proposer shall detail and recommended current-production Communications Analyzer models that supports testing of P25 Phase I (FDMA) and Phase II (TDMA) radio subscriber units. Additionally, Proposer shall disclose those manufacturers who have implemented automated test and alignment/calibration software options that support their proposed radio subscriber units.

9.2.2 In addition to classic analog communications analyzer test modes (signal generator, spectrum analyzer, power meter, etc.), the proposed Communications Analyzer shall fully support

9.2.3 The TIA/EIA-102.CAAA measurement standard and includes:

9.2.3.1 Bit Error Rate (BER) test patterns
9.2.3.2 Symbol Deviation
9.2.3.3 Modulation Fidelity
9.2.3.4 Frequency Error
9.2.3.5 Power
9.2.3.6 Eye Diagrams

9.2.4 The proposed Communications Analyzer shall also fully support the following

9.2.5 P25 Phase II (TDMA) measurements of both H-CPM and H-DQPSK signals such as:

9.2.5.1 H-CPM and H-DQPSK (inbound modulation) modulation and demodulation
9.2.5.2 H-CPM and H-DQPSK eye diagram, distribution plot, and constellation
9.2.5.3 Generation of all H-CPM and H-DQPSK standard patterns
9.2.5.4 Unit-Under-Test (UUT) measurements for Phase 2 including modulation fidelity, symbol deviation, symbol clock error, frequency error, power and TX bit error
9.2.5.5 Power profile diagrams of both full slots and ramp-up/ramp-down for H-CPM modulation
9.2.6 The Proposer shall also recommended any essential accessories for RF test and measurement, if not included by the manufacturer as standard. Examples include open, short, load devices, etc.

9.2.7 The Proposer shall include pricing for quantity fifteen (15) communications test sets.

9.3 P25 Automated Test and Alignment Feature

9.3.1 The proposed Communications Analyzer, in addition to supporting P25 measurement modes, shall also support automated test and alignment of an interfaced P25 radio subscriber unit:

9.3.2 Automated Alignments

9.3.2.1 Reference Oscillator
9.3.2.2 High, Medium and Low Power
9.3.2.3 Analog Deviation
9.3.2.4 Deviation Balance and Limiting
9.3.2.5 Front End Alignment (700/800 MHz band only)

9.3.3 Automated Performance Tests

9.3.3.1 P25 Modulation Fidelity
9.3.3.2 P25 Symbol Deviation
9.3.3.3 P25 Receive Bit Error Rate (BER)

9.4 Microwave Test Equipment (Qty. 9)

9.4.1 The Owner shall, as part of the replacement radio system, procure a latest-technology digital microwave transport system. Validating proper operation and diagnosing faults with the microwave infrastructure requires purpose-designed test equipment. The Proposer shall detail and recommended a current production test solution that supports the proposed microwave transport infrastructure.

9.4.2 The proposed test solution shall support the following features and measurements:

9.4.2.1 Spectrum Analyzer with upper frequency range/limit of 20 GHz
9.4.2.2 Frequency accuracy/error measurement
9.4.2.3 Power measurement
9.4.2.4 Coaxial Cable or Waveguide Insertion Loss measurements
9.4.2.5 Coaxial Cable or Waveguide Return Loss measurements
9.4.2.6 Coaxial Cable or Waveguide Distance To Fault (DTF) measurements
9.4.2.7 2-m armored test cables
9.4.2.8 Calibration shorts, opens

9.4.3 The proposed Microwave analyzer shall have a minimum usable RF frequency range of 100 MHz - 20 GHz to accommodate potential licensed microwave frequency bands used by the Owner.
9.4.4 The Proposer shall also recommended any essential accessories for microwave test and measurement, if not included by the manufacturer as standard.

9.4.5 The Proposer shall include pricing for quantity nine (9) microwave test sets.

9.5 Passive Intermodulation (PIM) Testing Equipment (Qty. 5)

9.5.1 PIM is an increasing performance issue for radio system operators, especially for digital systems using TDMA technology and multiple combined transmit signals. PIM issues may also be exacerbated for radio sites co-located with commercial wireless carriers operating in the adjacent channel blocks of the shared 700 MHz and 800 MHz bands.

9.5.2 PIM creates interference that reduces a base station’s receive sensitivity both internally and in other receivers located nearby or on-site. PIM severity is proportional to power level and new P25 Phase II base station transmitters produce higher Peak Instantaneous Power (PIP) levels than Phase I (FDMA) counterparts due to the Amplitude Modulation (AM) and TDMA component of their transmitted waveform. Owner radio shop staff shall have adequate equipment and training to deal with site performance issues that are attributable to a PIM environment.

9.5.3 The Proposer shall recommend a current production PIM tester suitable for use with the performance characteristics of the proposed analog VHF, UHF and P25 Phase I/II (TDMA) combiners, receiver multicouplers, antennas and related antenna system components. The PIM tester shall, as a minimum, support the following test and measurement functions:

9.5.3.1 PIM versus Time
9.5.3.2 Swept PIM
9.5.3.3 Distance to PIM (DTP)

9.5.4 The Proposer shall provide pricing information for a quantity of five (5) PIM test units.

9.6 Mobile RF Direction Finding (DF) Equipment (Qty. 7)

9.6.1 Mitigation of RF interference conditions is a highly technical and time consuming task for the Owner’s radio technicians. The ability to utilize specialized equipment to simplify this task will ensure highest performance from the new radio system and provide quickest problem resolution to interference events.

9.6.2 The proposed mobile DF solution shall have the following characteristics:

9.6.2.1 Doppler-based technology
9.6.2.2 Vehicular roof mounted antenna pod
9.6.2.3 Frequency coverage range of VHF, UHF, 700 MHz and 800 MHz bands
9.6.2.4 Portable capability (hand-held desirable)

9.6.3 The Proposer shall provide pricing for a quantity of seven (7) DF units.

9.7 Fiber Optic Test Equipment (Qty 8)

9.7.1 The Proposer shall detail and recommended current-production Optical Communications Analyzer models that supports testing of single-mode (SMF) and multi-mode fiber (MMF).
9.7.2 Proposer shall provide recommended make and model of suitable Optical Communications Analyzer.

9.7.3 The provided instrument shall support the following features:

9.7.3.1 Optical Time Domain Reflectometer (OTDR) mode
9.7.3.2 “Multi-stream” testing (layer 2 or 3) to test and debug QoS policies in the transport network
9.7.3.3 Loop-back feature to remotely loop-back an Ethernet port
9.7.3.4 MAC “swap” for use in a switched (VPLS) environment.

9.8 **STI Coverage Test Packages with Receivers (Qty 2)**

9.8.1 The Proposer shall offer a mobile drive test solution to permit the measurement and recoding of system RSSI and BER values for system analysis by the Owner’s radio technician staff. The desired product solution is “Field Test” by Survey Technologies Incorporated (STI). The Proposer shall offer two (2) integrated signal measurement systems as an assembled, turn-key package to include software and laptop computer and connected receiver.

9.9 **Other Vendor Recommended Test Equipment**

9.9.1 The Proposer shall recommend any other current-production test equipment related to proper system operation, maintenance and fault diagnosis.
10 INSPECTION AND TESTING REQUIREMENTS

10.1 System Factory Staging and Acceptance for LMR System Infrastructure

10.1.1 The system factory staging and factory acceptance test process is intended to ensure that all system components have been properly configured and integrated prior to the field delivery of system components. Staging provides an opportunity for the system Proposer to resolve any technical issues while located in a controlled environment with ready access to factory engineering support and manufacturing resources.

10.1.2 Inclusion of the factory staging process is required as a part of the response to this RFP and should be indicated on the Proposal schedule. Owner reserves the right to request specific tests to be performed as it sees fit during the factory acceptance test, including the rerunning of specific tests if deemed necessary by Owner.

10.2 Inspection of Equipment

10.2.1 Owner shall perform 100% inspection of all staged PSERN infrastructure equipment. This inspection process verifies that all equipment is configured and installed in a craftsman-like manner in accordance with the detailed design.

10.3 Test of all Proposed Vendor Subscriber Radios

10.3.1 For the Factory Staging Test, the Proposer shall include representative examples of all radio subscriber unit models included in their offering to participate in the testing regimen. This is to ensure all offered model tiers and variants are successfully demonstrated so as to duplicate the exact same product families the Owner shall take receipt of and field in the replacement radio system. This shall include representative examples of each offered radio tier, to also include control station configurations and special-purpose variants meeting the radio subscriber requirements of the RFP and delivered system.

10.4 Supplied Measurements of Performance Values

10.4.1 This test demonstrates that the system performs to manufacturer equipment specifications by examination of sample test data. System levels shall be tested at a level of 5% sampling of all infrastructure elements by Proposer and all values made available for Owner review.

10.4.2 These tests shall include:

10.4.2.1 Base Station Transmit Output Power
10.4.2.2 Transmitter Combiner Port Power Loss
10.4.2.3 System Sensitivity through Receiver Multicoupler (sites without TTA)
10.4.2.4 Effective System Sensitivity
10.4.2.5 Transmitter Frequency Error, Transmitter BER, Modulation Fidelity

10.5 Functional Acceptance Testing

10.5.1 Factory staging shall also include customer review of system operation and basic functional testing. This structured test demonstrates that all equipment features perform as specified in the Proposal, the system design and manufacturer's specification documents.
10.5.2 Wide Area Trunking Feature Tests shall include at a minimum the following:
   10.5.2.1 Talkgroup Call
   10.5.2.2 Wide Area Talkgroup Call
   10.5.2.3 Continuous Assignment Updating
   10.5.2.4 Private Call
   10.5.2.5 Call Alert
   10.5.2.6 Secure-to-Secure, and Secure-to-Clear Operation
   10.5.2.7 Busy Queuing and Callback with Ten Talkgroup Priority Levels
   10.5.2.8 Emergency Alarm and Call with Top of Queue (revert and non-revert)
   10.5.2.9 Emergency Alarm and Call with Ruthless Preemption
   10.5.2.10 Over the Air Programming
   10.5.2.11 Demonstrate seamless dynamic assignment of channels between dual (Phase I FDMA and Phase II TDMA) radio subscriber units

10.5.3 Wide Area Trunking from Dispatch Tests shall include at a minimum the following:
   10.5.3.1 Talkgroup Selection and Call
   10.5.3.2 Instant Transmit
   10.5.3.3 PTT Unit ID/Alias Display
   10.5.3.4 Call and Emergency Activity Log
   10.5.3.5 Call Alert
   10.5.3.6 Console Priority
   10.5.3.7 Emergency Alarm and Call Display
   10.5.3.8 Console Instant Recall Recorder
   10.5.3.9 Multi-Select Operation
   10.5.3.10 Talkgroup Patch
   10.5.3.11 Channel Marker Tones
   10.5.3.12 Individual Tone Pages
   10.5.3.13 Tone Generation over Trunking
   10.5.3.14 Conventional Call
   10.5.3.15 Frequency Selectable Conventional Resource
   10.5.3.16 Patch Operation - Conventional

10.5.4 Station Control on IP-Based Conventional Channel - Frequency Select Test
   10.5.4.1 Talkgroup Patch with Conventional
   10.5.4.2 Tone Generation on Conventional Resource
   10.5.4.3 Logging Audio from Console Audio Source
   10.5.4.4 Dispatch Console Auxiliary Control Inputs/Outputs
10.5.4.5 Wide Area Trunking Features – System Management
10.5.4.6 Radio System Event Display and Management - Views
10.5.4.7 Trunked Channel Assignments
10.5.4.8 Radio Successfully Authenticates
10.5.4.9 Historical Reports
10.5.4.10 System Configuration Reports
10.5.4.11 Radio Check
10.5.4.12 Selectively Inhibit a Radio and Re-enable
10.5.4.13 Radio Locate
10.5.4.14 Dynamic Regrouping
10.5.4.15 Remote Base Station Equipment Programming

10.5.5 KMF and Over the Air Rekeying (OTAR) Tests
10.5.5.1 Keyset Changeover
10.5.5.2 Adding Keys to the Key Kettle
10.5.5.3 Creating CKRs - Common Key References
10.5.5.4 Creating Common Key Encryption Keys
10.5.5.5 Creating Subscriber Units
10.5.5.6 KMF Summary Report

10.5.6 ISSI.1 System Interconnection Tests
10.5.6.1 Home System Initiated Talkgroup Call
10.5.6.2 Emergency Call
10.5.6.3 Manual Roaming between Systems

10.5.7 Failure Scenarios and Fault Management Tests
10.5.7.1 System Component Failures
10.5.7.2 Station Failure
10.5.7.3 Multiple Control Channel Failure
10.5.7.4 Multiple Traffic Channel Failure
10.5.7.5 Site Link Failure
10.5.7.6 Site Router Failure
10.5.7.7 Redundant Controller Switching – Manual Switchover
10.5.7.8 Redundant Switching - Automatic Switchover
10.5.7.9 Site Trunking Feature
10.5.7.10 Talkgroup Call
10.5.7.11 Site Trunking Roaming to Wide Area Sites
10.5.7.12 Redundant Site Controller Switching - Automatic Switchover
10.5.7.13 Wide Area Recovery- Single Site
10.5.7.14 Wide Area Recovery- All Sites in Site Trunking
10.5.7.15 Failsoft (loss of site control channels or functional equivalent)
10.5.7.16 Redundant Console Site Link Failure
10.5.7.17 Full or complete console site link failure
10.5.7.18 Console Position Failure
10.5.7.19 Console Encryption Key Fail and Re-Load Key to Normal Operation
10.5.7.20 Console Connected Backup Control Stations
10.5.7.21 Stand Alone Backup Dispatch Control Stations

10.5.8 Fault Management Tests
10.5.8.1 Core Router Failure Reports to the NMS
10.5.8.2 Console Link Failure Reports to the NMS
10.5.8.3 Station Failure Reports to the NMS
10.5.8.4 Site Path Failure (connectivity failure) Reports to the NMS
10.5.8.5 Alarm System Physical Inputs/Outputs - Digital Inputs
10.5.8.6 VHF/UHF/700 MHz/800 MHz Conventional Voice Channel Failure
10.5.8.7 System Management Alerts to cellphones

10.5.9 Subscriber Tests
10.5.9.1 Multi-Vendor Testing (TDMA)
10.5.9.2 Talkgroup (FDMA)
10.5.9.3 Subscriber Roaming
10.5.9.4 Time-out Timer
10.5.9.5 Priority Scan
10.5.9.6 Mixed Trunked Talkgroup and Conventional Scan

10.5.10 Logging Recorder Tests
10.5.10.1 Demonstrate user can only search for recordings which match their profile
10.5.10.2 Verify that only user assigned channels appear within the player
10.5.10.3 Verify recordings are written to a NAS partition on a recorder logical drive
10.5.10.4 Verify Search Function within the player so that only recordings assigned to each user are found on the channel
10.5.10.5 Demonstrate saving a file to the desktop or CD
10.5.10.6 Verify audio file redaction of a selected section of audio from a call
10.5.10.7 Demonstrate selected and copying a recorded day to file
10.5.11 Miscellaneous Tests
  10.5.11.1 Base Station CW Identification

10.6 Submission of Factory Acceptance Test Plan Documentation Samples
  10.6.1 Proposer shall submit a sample factory acceptance test plan which includes these required elements with their Proposal. This factory acceptance test plan shall define the tests to be performed by the Proposer for each phase of the Factory Acceptance Test to verify that the system performs in accordance with contract specifications.
  10.6.2 Where specified, the test results shall reflect both quantitative and qualitative data, not just pass/fail determination. Proposers shall detail their understanding of how this process shall be conducted, detail deliverables, and identify any associated costs. A final Factory Acceptance Test Plan shall be developed during the detailed design review process.

10.7 LMR System Field Acceptance Testing For System Infrastructure
  10.7.1 The system field acceptance test process is intended to ensure that all system components have been properly installed, tested and prepared for commissioning.
  10.7.2 Inclusion of the field acceptance test process is required as a part of the response to this RFP and shall be indicated on the Proposal schedule. Owner reserves the right to request specific tests to be performed as it sees fit during the field acceptance test, including the rerunning of specific tests if deemed necessary by Owner.

10.8 Inspection of Equipment
  10.8.1 Owner shall perform 100% inspection of all installed PSERN infrastructure equipment at all sites and dispatch centers. This inspection process verifies that all equipment is configured and installed in a craftsman-like manner in accordance with the detailed design.

10.9 Test of all Proposed Vendor Subscriber Radio Models
  10.9.1 For the Field Acceptance Test, the Proposer shall include representative examples of all radio subscriber unit models included in their offering to participate in the testing regimen. This is to ensure all offered model tiers and variants are successfully demonstrated so as to duplicate the exact same product families the Owner has taken receipt of in the replacement radio system. This shall include representative examples of each offered radio tier, to also include control station configurations and special-purpose variants meeting the radio subscriber requirements of the RFP and delivered system.

10.10 Supplied Measurements of Performance Values
  10.10.1 This test demonstrates that the system performs to manufacturer equipment specifications by examination of sample test data. System levels shall be tested at a level of 100% of all infrastructure elements by Proposer and all values made available for Owner review.
  10.10.2 These tests shall include:
    10.10.2.1 Base Station Transmit Output Power
    10.10.2.2 Transmitter Combiner Port Power Loss
10.10.2.3 System Sensitivity through Receiver Multicoupler (sites without TTA)
10.10.2.4 System Sensitivity through TTA
10.10.2.5 Effective System Sensitivity
10.10.2.6 Transmitter Frequency Error, Transmitter BER, Modulation Fidelity
10.10.2.7 Site Power System Voltage and Currents

10.11 Functional Acceptance Testing

10.11.1 Field testing shall also include customer review of system operation and full system functional testing. This structured test demonstrates that all equipment features perform as specified in the Proposal, the system design and manufacturer's specification documents.

10.11.2 These tests shall include at a minimum the following:

10.11.3 Wide Area Trunking Feature Tests
   10.11.3.1 Talkgroup Call
   10.11.3.2 Wide Area Talkgroup Call
   10.11.3.3 Continuous Assignment Updating
   10.11.3.4 Private Call
   10.11.3.5 Call Alert
   10.11.3.6 Secure-to-Secure and Secure-to-Clear Operation
   10.11.3.7 Busy Queuing and Callback with Ten Talkgroup Priority Levels
   10.11.3.8 Emergency Group Voice Call
   10.11.3.9 Preemptive Priority Call
   10.11.3.10 Over the Air Programming

10.11.4 Wide Area Trunking from Dispatch Tests
   10.11.4.1 Talkgroup Selection and Call
   10.11.4.2 Instant Transmit
   10.11.4.3 PTT Unit ID/Alias Display
   10.11.4.4 Call and Emergency Activity Log
   10.11.4.5 Call Alert
   10.11.4.6 Console Priority
   10.11.4.7 Emergency Alarm and Call Display Description
   10.11.4.8 Console Instant Recall Recorder
   10.11.4.9 Multi-Select Operation
   10.11.4.10 Talkgroup Patch
   10.11.4.11 Channel Marker Tone
   10.11.4.12 Individual Tone Pages
   10.11.4.13 Tone Generation over Trunking
10.11.4.14 Conventional Call
10.11.4.15 Frequency Selectable Conventional Resource
10.11.4.16 Patch Operation - Conventional

10.11.5 Station Control on IP-Based Conventional Channel - Frequency Select Test
10.11.5.1 Talkgroup Patch with Conventional
10.11.5.2 Tone Generation on Conventional Resource
10.11.5.3 Logging Audio from Console Audio Source
10.11.5.4 Dispatch Console Auxiliary Control Inputs/Outputs

10.11.6 Wide Area Trunking Features – System Management Test
10.11.6.1 Radio System Event Display and Management - Views
10.11.6.2 Trunked Channel Assignments
10.11.6.3 Radio Successfully Authenticated
10.11.6.4 Historical Activity Reports
10.11.6.5 System Configuration Reports
10.11.6.6 Radio Check
10.11.6.7 Selectively Inhibit a Radio and Re-enable
10.11.6.8 Radio Locate
10.11.6.9 Dynamic Regrouping
10.11.6.10 Remote Base Station Equipment Programming

10.11.7 KMF and Over the Air Rekeying (OTAR) Tests
10.11.7.1 Keyset Changeover
10.11.7.2 Adding Keys to the Key Kettle
10.11.7.3 Creating CKRs - Common Key References
10.11.7.4 Creating Common Key Encryption Keys
10.11.7.5 Creating Subscriber Units
10.11.7.6 KMF Summary Report

10.11.8 ISSI.1 System Interconnection Tests
10.11.8.1 Home System Initiated Talkgroup Call
10.11.8.2 Emergency Call
10.11.8.3 Manual Roaming between Systems

10.11.9 Failure Scenarios and Fault Management Tests
10.11.9.1 System Component Failures
10.11.9.2 Station Failure
10.11.9.3 Multiple Control Channel Failure
10.11.9.4 Multiple Traffic Channel Failure
10.11.9.5 Site Link Failure
10.11.9.6 Site Router Failure
10.11.9.7 Redundant Controller Switching – Manual Switchover
10.11.9.8 Redundant Switching - Automatic Switchover
10.11.9.9 Site Trunking Feature
10.11.9.10 Talkgroup Call
10.11.9.11 Site Trunking Roaming to Wide Area Sites
10.11.9.12 Redundant Site Controller Switching - Automatic Switchover
10.11.9.13 Wide Area Recovery- Single Site
10.11.9.14 Wide Area Recovery- All Sites in Site Trunking
10.11.9.15 Failsoft
10.11.9.16 Redundant Console Site Link Failure
10.11.9.17 Console Position Failure
10.11.9.18 Console Encryption Key Fail and Re-Load Key to Normal Operation
10.11.9.19 Console Connected Backup Control Stations
10.11.9.20 Stand Alone Backup Dispatch Control Stations

10.11.10 Fault Management Tests
10.11.10.1 Core Router Failure Reports to the NMS
10.11.10.2 Console Link Failure Reports to the NMS
10.11.10.3 Station Failure Reports to the NMS
10.11.10.4 Site Path Failure (connectivity failure) Reports to the NMS
10.11.10.5 Alarm System Physical Inputs/Outputs - Digital Inputs
10.11.10.6 VHF/UHF/700 MHz 800 MHz Conventional Voice Channel Failure
10.11.10.7 System Management Alerts to Cellphones

10.11.11 Subscriber Tests
10.11.11.1 Multi-vendor Testing (TDMA)
10.11.11.2 Talkgroup (FDMA)
10.11.11.3 Subscriber Roaming
10.11.11.4 Time-out Timer
10.11.11.5 Priority Scan
10.11.11.6 Mixed Trunked Talkgroup and Conventional Scan

10.11.12 Logging Recorder Tests
10.11.12.1 Demonstrate user can only search for recordings which match their profile
10.11.12.2 Verify that only user assigned channels appear within the player
10.11.12.3 Verify recordings are written to a NAS partition on a recorder logical drive

10.11.12.4 Verify Search Function within the player so that only recordings assigned to each user are found on the channel

10.11.12.5 Demonstrate saving a file to the desktop or CD

10.11.12.6 Verify audio file redaction of a selected section of audio from a call

10.11.12.7 Demonstrate selected and copying a recorded day to file

10.11.13 Miscellaneous Tests

10.11.13.1 Base Station CW Identification

10.12 Coverage Acceptance Test Plan (CATP) For Voice Overview

10.12.1 A key aspect of field test and acceptance is a determination that the radio system coverage meets the requirements of the radio system purchase contract. This process is described in a separate Coverage Acceptance Test Plan or CATP.

10.12.2 The Coverage Acceptance Test Plan is intended to be the foundation for the final Coverage Acceptance Testing for the new Owner system. A draft of the CATP is provided as a part of this RFP. The final details of the CATP shall be mutually agreed upon by Owner and Proposer during the final design review phase of the project. The cost to provide the level of testing described in this document shall be included in the Proposal.

10.12.3 The Coverage Acceptance Test Plan is designed to verify that the P25 voice and P25 data radio system implemented by Proposer meets or exceeds the required coverage reliability within the King County service area as indicated on Proposer’s Proposal coverage maps. The CATP defines the coverage testing method and procedure, the Owner coverage acceptance test criteria, the required test documentation, and the responsibilities of both Owner and Proposer.

10.12.4 To verify that the radio coverage reliability is met, the indicated coverage area within the King County operating area shall be divided into a predetermined number of equally sized test tiles. The final tile size shall be specified by Owner in the detailed design process.

10.12.5 For the trunked P25 portion of the system, Proposer shall verify the coverage and system performance through Bit-Error-Rate (BER) testing and subjective audio quality tests. Proposer shall also collect signal strength measurements simultaneously for informational purposes and deliver this data to Owner.

10.12.6 The Proposer shall not be responsible for coverage performance testing of the VHF analog, UHF analog, and 800 MHz analog infrastructure specified in Section 4.

10.13 Submission of Field Acceptance Test Plan Documentation Samples

10.13.1 Proposer shall submit a sample field acceptance test plan which includes these required elements with their Proposal. This field acceptance test plan shall define the tests to be performed by the Proposer for each phase of the field acceptance test to verify that the system performs in accordance with contract specifications. Where specified, the test results shall reflect both quantitative and qualitative data, not just pass/fail determination. Proposers shall detail their understanding of how this process shall be conducted, detail deliverables, and identify any associated...
costs. A final field acceptance test plan shall be developed during the detailed design review process.

10.13.2 Coverage Acceptance Testing is based upon a coverage prediction that accurately represents the implemented infrastructure and parameters that are consistent with the Proposal. If, based on design revisions jointly agreed to between Owner and Proposer, and the implemented system varies from the design parameters in the predicted coverage, and then revised coverage maps shall be prepared.

10.14 Coverage Acceptance Test Plan (CATP) Definitions

10.14.1 Several definitions are needed to accurately describe the coverage test method. Where cited, these terms or methods are defined in TIA TSB-88.1-C or TIA TSB-88.3-C, and as follows:

10.14.2 Coverage Area - The coverage area is the geographical region in which communications shall be provided which meets or exceeds the specified Channel Performance Criterion at the specified reliability for the specified equipment configuration(s). Radio systems are typically designed to maximize the coverage area within the customer's service area (users' operational area, jurisdictional boundaries, etc.) (TSB-88.1-C, §5.1) The predicted coverage area for this system, within which an area coverage percentage is at least 97% or the area, at a reliability level of 97%, shall be indicated on Proposer's coverage maps.

10.14.3 Channel Performance Criterion (CPC) - The Channel Performance Criterion (CPC) is the specified minimum design performance level in a faded channel per TSB 88.1-C, §5.2. For the PSERN, the CPC is a Delivered Audio Quality (DAQ) of 3.4 or greater. The DAQ definitions are provided in table below (from TSB-88.1-C, §5.4.2, Table 2). Given the static reference sensitivity of a receiver, the faded performance threshold for the specified CPC is determined by using the projected CPC requirements for different DAQs listed in TSB-88.1-C, Annex A, Table A-1. The CATP pass / fail criterion for each test location is the faded performance threshold, plus any adjustments for antenna performance or in-vehicle losses (per TSB-88.1-C, §5.4.2, Figure 5).

10.14.4 Delivered Audio Quality (DAQ) Level – A subjective Performance Description based upon a Mean Opinion Score, as follows:

10.14.4.1 Unusable, speech present but unreadable
10.14.4.2 Understandable with considerable effort. Frequent repetition due to noise/distortion
10.14.4.3 Speech understandable with slight effort. Occasional repetition required due to noise/distortion
10.14.4.4 Speech understandable with repetition only rarely required. Some noise/distortion
10.14.4.5 Speech easily understood. Occasional noise/distortion
10.14.4.6 Speech easily understood. Infrequent noise/distortion
10.14.4.7 Speech easily understood
10.14.4.8 Note: TSB-88 uses the term “noise” only to describe perceived signal characteristics for analog radio systems. Noise as used in this table only applies to analog radio systems. For the primary PSERN, only ‘distortion’ shall be used in the DAQ testing process for digital systems.
If DAQ testing is used for the analog mutual aid systems on VHF, UHF or the 8CALL and 8TAC channels, the evaluation criteria to be used shall be “noise”.

10.14.5 Pass/Fail - The pass / fail criterion is the faded performance threshold for the specified CPC, plus any adjustments for antenna performance or in-vehicle losses. For APCO Phase 2 TDMA, the CPC pass criterion for DAQ-3.4 is 2.4% BER or less for talk-out, and 2.6% BER or less for talk-in (TSB-88.1-D, Table A-1)

10.14.6 Reliability - The reliability is the percentage of locations within the coverage area that meet or exceed the specified CPC. The defined service area where the target reliability levels must be met have been provided to Proposer in the RFP process as both a graphic and as ‘shape’ (.shp) files. Proposer’s coverage maps indicate the area within which this system is predicted to provide at least 97% area coverage at a 97% probability of meeting or exceeding a DAQ-3.4. (TSB-88.1-C, §5.3.2; not regulatory contour reliability).

10.15 Resource Dedication for CATP Completion

10.15.1 Proposer shall provide adequate staffing and as many coverage test kits as required to provide portable and mobile testing simultaneously. It is desired to complete coverage testing within as short a period of time as possible. Proposer shall state the number of total mobile and portable test kits required to complete the work in a timely and professional manner and shall state the period of time in their proposal that shall be required to complete all elements of the CATP process.

10.16 Coverage Acceptance Test Plan (CATP) Round Trip Performance Test

10.16.1 Because the design for the replacement radio system dictates a P25 Phase 2 (TDMA) trunked radio system, using a balanced transmit-receive design, and a full handshake between the subscriber radio and the system infrastructure is required, coverage testing shall be based upon round-trip (outbound and inbound) performance.

10.16.2 This test shall provide the measured BER testing. Subjective DAQ audio quality tests shall also be provided and criteria must be met in order for the system to be accepted. Informational signal strength measurements shall be taken concurrent with BER testing.

10.16.3 Coverage testing of FDMA mode shall not be required.

10.17 Coverage Testing Equipment Configurations

10.17.1 Proposers are required to provide coverage maps based on both mobile and portable configurations. As a result, the Coverage Acceptance Testing procedure shall be based on simultaneous coverage testing in both a portable and a mobile coverage configuration.

10.17.2 Mobile Test Configuration:

10.17.2.1 Tests coverage to the proposed high-tier, single band mobile radio

10.17.2.2 Antenna used shall be a unity gain (0 dBd) mobile antenna mounted on the roof of the vehicle which is at approximately 5 feet above the ground

10.17.2.3 Antenna has no obstructions near it to impact performance (roof mounted objects)
10.17.3 Portable Test Configuration:

10.17.3.1 Coverage to the proposed high-tier, single band portable radio

10.17.3.2 Antenna used shall be a unity gain (0 dBd) mobile antenna mounted externally on the roof test vehicle to best to best capture on-street portable coverage performance

10.17.3.3 Attenuation shall be added such that the total antenna system gain shall mimic that of a portable radio worn on the hip with a ½ wave antenna as the standard antenna, utilizing a Proposer-provided non-swivel case. Attenuation values shall be determined through consultation with Owner

10.17.3.4 Antenna has no obstructions near it to impact performance (roof mounted objects)

10.17.3.5 Antenna has proper ground plane per manufacturer’s recommendation

10.18 Coverage Acceptance Test Plan (CATP) Outdoor Testing Method

10.18.1 The method used to test coverage is representative statistical sampling of the predicted coverage area to verify that the Channel Performance Criteria (CPC) is met or exceeded at the required reliability for the desired equipment configurations. Proposer shall test both the Mobile and Portable predicted coverage maps. Because it is nearly impossible to verify every point within a coverage area, coverage reliability shall be verified by sampling a statistically significant number of randomly selected locations, quasi-uniformly distributed throughout the predicted coverage area.

10.18.2 This CATP provides an objective, quantitative method of measurement using Proposer’s coverage test hardware and software.

10.18.3 The method follows TIA TSB-88.3.C §5.0, “Performance Confirmation”, and Proposer states by their Proposal, that the method used has a direct and unambiguous correlation with Proposer’s coverage prediction methodology.

10.19 Determination of the Required Number of Test Tiles in the Coverage Area

10.19.1 The predicted coverage area shown on Proposer’s coverage maps shall be divided into a tile pattern to produce at least the number of uniformly sized test locations required by the Estimate of Proportions formula. \{TSB-88.3-C, §5.2.1, equation 2\} The minimum number of test tiles required varies for different systems, from a hundred to many thousands, depending on the size of the coverage area, desired confidence in results, type of coverage test, and the predicted versus required reliability.

10.20 Constraints on Test Tile Sizes

10.20.1 The minimum test tile size recommended by TSB-88 is 100\(\lambda\) by 100\(\lambda\) wavelengths; however, the minimum practical test tile size is typically about 400 by 400 meters (about 0.25 by 0.25 miles). The minimum practical size for any system is determined by the distance traveled at the speed of the test vehicle while sampling, GPS error margin, and availability of road access within very small tiles. The maximum test tile size is 2 km by 2 km (1.25 by 1.25 miles). \{TSB-88.3-C, §5.5.1\}. In some wide-area systems, this constraint on maximum size may
dictate a greater number of test locations than the minimum number required by
the Estimate of Proportions formula.

10.20.2 For test purposes, with the exception of dense downtown areas, as defined in the Coverage Requirements, King County shall be divided into uniform square grids of approximately 1/2 mile by 1/2 mile in area. For better testing resolution in dense urban areas, dense urban areas of King County shall be divided into 1/10 mile by 1/10 mile grids.

10.21 Accessibility to Test Tiles

10.21.1 Prior to testing, Proposer and Owner shall determine whether any test tiles are fully inaccessible for the coverage test (due to lack of roads, restricted access, etc.). Inaccessible tiles shall be eliminated by agreement of the Owner from the acceptance test calculation (TSB-88.3C, §5.5.4).

10.21.2 If mutually agreed upon by Owner and Proposer, TSB-88.3-C provides consideration for inaccessible test locations called “estimated based on adjacent grids (single grids only)”. Single inaccessible test locations shall be considered a “pass” if five (5) of the eight (8) surrounding test tiles provide passing results, provided that the CATP test tiles are defined as follows:

10.21.2.1 Only those test tiles where the majority of the tile falls within the boundaries of the CATP area under test
10.21.2.2 Those test tiles within the CATP boundaries that are actually tested
10.21.2.3 Inaccessible test tiles which are surrounded by not less than five (5) contiguous test tiles which have been tested and show an actual passing result (untested test tiles are not counted)
10.21.2.4 Any other untested test tiles that do not fit any of the criteria above (e.g., untested test tiles surrounded by other untested test tiles, or less than five passed test tiles, etc.) shall be categorized as simply “untested” and shall not be factored into the results as a “CATP tile”
10.21.2.5 Because of the requirement to provide reliable service to significant bodies of water within King County, water areas shall be tested. Owner shall provide water transport as required to support this testing process.

10.21.3 If elimination of inaccessible test tiles results in less than a statistically significant number of test tiles or, in the opinion of Owner, substantially alters the defined test area, Owner reserves the right to adjust the committed reliability based on the reduced number of accessible test tiles within the altered test area and the Estimate of Proportions formula (TSB-88.3-C-1, §5.2.1, equation 2).

10.22 Randomly Select a Test Location within Each Tile

10.22.1 Using the Proposers coverage test software system, the actual test location within each tile shall be randomly selected by the test vehicle crossing into the tile at an arbitrary point, with an arbitrary speed and direction. If the selected test location is in an underground parking garage, in a tunnel or other obviously enclosed location, the test location may, with the consent of the Owner representative, be marked as invalid and a replacement test location selected through mutual agreement of the Proposer representative and the Owner representative.
10.23 Perform Measurements in Each Tile

10.23.1 In each test tile, a series of sequential measurements (subsamples) shall be made while the test vehicle is moving at a typical speed for the surrounding environment. This test location measurement, containing a number of subsamples, constitutes the test sample for this location. The test sample shall establish the local mean BER and median signal level within the test tile. The subsamples shall be measured for at least 2 seconds for BER, or over a distance of 40 \( \lambda \) wavelengths for a signal level.

10.23.2 A mean of multiple BER sub-samples, or a median of multiple signal strength subsamples is used rather than a single measurement to ensure that the measurement is not biased by taking a single sample that might be at a peak or null point on the radio wave.

10.23.3 It is expected that the radio(s) used in the test method shall be configured with standard software to allow normal subscriber roaming from site to site. Therefore the testing shall be based primarily on the best signal strength available as it is measured by the test radio.

10.23.4 Determine if Each Tile Passes or Fails the CPC Requirement for Each Equipment Configuration

10.23.5 For each tile, the pass / fail criterion is the faded performance threshold for the specified CPC, plus any adjustments for antenna performance or in-vehicle losses. For APCO Phase 2 TDMA, the CPC pass criterion for DAQ-3.4 is 2.4% BER or less for talk-out, and 2.6% BER or less for talk-in (TSB-88.1-D, Table A-1).

10.24 Signal Strength Measurements

10.24.1 Proposer shall collect mobile signal strength measurements simultaneously with the BER testing. Maps showing the signal strength measurements, both outbound and inbound, shall be delivered to the Owner.

10.24.2 Determine the Coverage Area Reliability for Acceptance

10.24.3 After all accessible tiles in the coverage area have been tested; the coverage area reliability (%) shall be determined by dividing the number of tiles that pass by the total number of tiles tested. (TSB-88.3-C, §5.1, equation 1). The coverage test acceptance criterion is that the tested coverage area reliability must be equal to or greater than the required reliability specified in the definitions section of this document.

10.25 General Description Of Subjective Audio Testing Method

10.25.1 The PSERN Coverage Acceptance Test Plan (CATP) shall also require the evaluation of inbound and outbound subjective audio quality. Additionally, this test shall require audio meet the required performance both between a field user and a dispatch console, as well as between two field users, one using a portable radio and one using a mobile radio. A minimum of one (1) subjective test shall be performed from each and every tile.

10.25.2 The first team shall be located at a designated dispatch center, with a second team in the field (field team one). A second field team (field team two) shall also be located within the same grid as the first field team. Field team one shall utilize a GPS receiver to determine the location of the team within pre-printed grid maps prior to taking a test sample. Field team one shall transmit and the dispatch team shall respond. Both field team one and the dispatch team shall rate the audio
quality. Then Field team one shall transmit and field team two shall respond. Both field team one and field team two shall rate the audio quality. All grids determined to meet the Channel Performance Criterion (CPC) as defined in the definitions section of this document shall be considered passing. These grids shall be counted as grids in the overall CATP, with both the BER test data and the DAQ data being required to ‘pass’. A failure of either is a failure of both for the grid square.

10.26 Responsibilities And Preparation For Coverage Testing

10.26.1 This information shall help set the expectations of Owner and Proposer regarding requirements for equipment, personnel, and time during the coverage test.

10.26.2 Wide Area CATP Testing Resources - Owner shall provide the following for the duration of the coverage test:

10.26.2.1 At least one test vehicle that is representative of the vehicles to be equipped with mobile radios, including antenna location

10.26.2.2 At least one Owner representative, to drive each test vehicle and/or to be the customer representative(s) for the test team(s)

10.26.2.3 A second Owner representative shall observe testing

10.26.2.4 Subscriber radios configured for the Owner system

10.26.2.5 The Owner may elect to provide and run the Signal Technology Incorporated (STI) test kit to be done concurrently with the Proposer’s coverage testing. Data gathered would be for Owners internal use

10.26.3 Proposer Responsibilities – The Proposer shall provide the following for the duration of the coverage test:

10.26.3.1 At least one Proposer representative to navigate and to operate test equipment and one representative for the dispatch team

10.26.3.2 At least one calibrated test equipment coverage testing package

10.26.3.3 At least one laptop computer equipped with coverage test software

10.26.4 Route Planning and Test Execution

10.26.4.1 Coverage acceptance testing shall be performed in the portions of Owner’s operating area predicted by Proposer to provide the required reliability, as indicated on the coverage maps. County shall determine the minimum number of test tiles required, as described in the Method Section of this CATP.

10.26.4.2 Proposer and Owner shall plan the route for the test vehicles through the coverage test area, to ensure that at least the minimum required number of tiles are tested. Any tiles not accessible to the test vehicles or test marine craft shall be identified while planning the route and shall be removed from the area to be tested.

10.26.4.3 Proposer shall conduct this test only once. If any portion of the test is determined to be unreliable because of proven equipment malfunctions or failures, Proposer shall repeat the portion of the test affected by the equipment malfunction or failure.
10.26.4.4 Proposer shall calibrate the test receivers used with the coverage testing package. The test receivers shall be provided by Proposer.

10.27 Coverage Measurements Outside of Defined Service Area

10.27.1 No required acceptance testing shall be performed in locations on Proposer’s coverage maps predicted to be below the required reliability. Proposer agrees to perform “information only” tests at such locations; however, these “information only” test results shall not be used for coverage acceptance. “Information only” test locations shall be defined before starting the test.

10.28 Coverage Acceptance Test Plan (CATP) Schedule

10.28.1 Before starting the test, Owner and Proposer shall agree upon the time frame for CATP testing and for the Proposer’s submission of a report containing the coverage test results.

10.29 Bit Error Rate Testing Procedures

10.29.1 Proposer shall use its coverage test kit to analyze the Bit-Error-Rate (BER). Proposer shall also collect signal strength measurements in dBm for informational purposes. Proposer shall also complete a quantitative coverage acceptance test to provide objective BER verification that the system provides the faded performance threshold for the specified CPC.

10.29.2 Equipment Configurations - Coverage test kits are assumed to consist of the following:

10.29.2.1 A calibrated test receiver, connected to an antenna installed in a representative location on the test vehicle. The test receiver shall monitor transmissions from the fixed network radio site(s). The calibrated test receiver shall be a mobile and portable radio fully representative of the proposed high-tier subscriber mobile and portable radio

10.29.2.2 A Global Positioning System (GPS) receiver, which shall provide the computer with the location and speed of the test vehicle

10.29.2.3 A laptop computer with Proposer software and a mapping database, which includes highways and local streets, political boundaries, lakes and rivers, railroads, etc.

10.29.2.4 The procedure for the BER coverage test shall be as follows:

10.29.2.4.1 The Proposer CATP test package shall be installed in a test vehicle. Owner personnel shall drive the test vehicle over a route planned to cover the accessible tiles within the coverage test area. Proposer personnel shall operate the Proposer CATP test package

10.29.2.4.2 During the coverage test, the laptop computer shall display the vehicle’s location on a map of the coverage test area overlaid with the test tiles. Proposer CATP test package shall automatically initiate signal level measurements when the GPS receiver indicates that a tile has been entered. The computer shall provide a visual indication that a measurement has been completed in a tile. Proposer CATP test package shall
manage the coverage test data collection, and store for later analysis the outbound reference signal level measured in each tested tile. Inbound signal BER data shall similarly be collected and delivered to the coverage test software.

10.29.2.4.3 Coverage acceptance shall be based on demonstrating that the required percentage of the tiles in the coverage test areas are measured to provide the required BER and have passed the DAQ test. Additionally, both mobile and portable BER and DAQ tests shall “pass”.

10.29.2.4.4 If a coverage test, or a portion thereof, is suspected by Proposer to have failed due to external interference, those tiles suspected of being affected by an interferer may be re-tested.

10.30 Delivered Audio Quality (DAQ) CATP Testing Procedures

10.30.1 Owner and Proposer representatives shall perform audio quality measurements during the drive test. Note that while single test processes are described, Proposer and Owner may agree to run multiple concurrent test processes.

10.30.2 As mentioned in the earlier, it is impractical to have a large group of people for a subjective listening test. Therefore it is imperative that all personnel who will evaluate audio quality be “conditioned” or “calibrated” by listening to examples of audio that pass and fail the subjective DAQ test.

10.30.3 The methodology used for DAQ testing shall be as follows:

10.30.4 Dispatch-To-Field Test

10.30.4.1 Proposer shall provide gridded maps for the predicted coverage area for the area to be tested.

10.30.4.2 Proposer shall provide at least one representative in the coverage area and at least one representative at the selected dispatch center to be used for the DAQ test.

10.30.4.3 Owner shall provide at least one representative in the coverage area to be used for the DAQ test and at least one representative at the selected dispatch center. Each Owner representative shall pair with a Proposer representative.

10.30.4.4 Utilizing a map of the predicted coverage area, the Owner representative and Proposer representative shall drive and/or walk the area to be tested.

10.30.4.5 Utilizing a GPS device, the Owner representative in the field shall annotate his coordinates at each point and communicate that location over the radio to dispatch.

10.30.4.6 Over the radio, the dispatch representative shall read back the field tester’s grid location and description and wait for the field tester to verify that it is correct. If the information related back is accurate, the inbound test for that grid square has PASSED.

10.30.4.7 If it is not correct, the field tester shall repeat the information one time. Read back the information over the console and wait for the field user...
to verify it is correct. If it is correct, the inbound test for that grid square has PASSED. If it is not correct, the inbound test for that grid square has FAILED. Record the Field Tester's grid square and location. Evaluate the quality of the audio and record in the test-results form as to whether or not required DAQ is met.

10.30.4.8 Over the radio, the dispatcher shall read a random phrase from the list provided

10.30.4.9 Listen for the field tester to transmit the phrase back, and verify it is correct. If it is correct, the outbound test for that grid square has PASSED. If it is not correct, the outbound test for that grid square has FAILED

10.30.4.10 Both directions must PASS for the grid square to pass

10.30.5 Field Unit-To-Field Unit Test

10.30.5.1 Proposer shall provide gridded maps for the predicted coverage area for the area to be tested

10.30.5.2 Proposer shall provide at least two representatives in the coverage area to be used for the DAQ test.

10.30.5.3 Owner shall provide at least two representatives in the coverage area.

10.30.5.4 Utilizing a map of the predicted coverage area, one Owner representative and one Proposer representative shall drive and/or walk the area to be tested. The Owner and Proposer representative team shall be located in a vehicle within the same grid square

10.30.5.5 Utilizing a GPS device, the Owner representative in the field shall annotate his coordinates at each point and communicate that location to the second team. Over the radio, a representative of the second team shall read back the grid location and description and wait for the other team to verify that it is correct

10.30.5.6 If the information is accurate and is received per the signal quality description of required DAQ, the inbound test for that grid square has PASSED. On a pre-prepared electronic test results form, the mobile radio team shall record the test grid square and location, evaluate the quality of the audio and record in the test-results form as to whether or not required DAQ is met

10.30.5.7 If it is not correct, the inbound test for that grid square has FAILED. On a pre-prepared electronic test results form, the mobile radio team shall record the test grid square and location, evaluate the quality of the audio and record in the test-results form as to whether or not DAQ-3.4 is met.

10.30.5.8 Over the radio, the first field tester shall read a random phrase from the list provided.

10.30.5.9 The second field tester shall listen for the first field tester to transmit the phrase and verify that it is correct. If it is correct, the outbound test for that grid square has PASSED. If it is not correct, that grid square has FAILED.
10.30.5.10 The second field tester shall then transmit the phrase back to the first field tester. The first field tester shall listen for the second field tester to transmit the phrase back, and verify that it is correct. If it is correct, the return test for that grid square has PASSED. If it is not correct, the return test for that grid square has FAILED.

10.30.5.11 Both directions must PASS for the grid square to pass.

10.30.6 The subjective audio quality grids shall be included with the overall quantity of test grids for determination of system coverage acceptance. Both objective and subjective tests must “pass” in order for the grid to be shown as “passed”. All test scoring sheets shall be provided to Owner at the conclusion of each day’s testing by Contractor.

10.31 Coverage Acceptance Test Plan (CATP) Test Data, Documentation and Acceptance

10.31.1 The Proposer CATP test package shall generate computer files that include the Reference Tile Levels for each test tile. A copy of this raw data in .CSV file format shall be provided to the Owner at the conclusion of the coverage test. All data shall be provided as an Excel spreadsheet or database data shall be provided.

10.31.2 Contractor shall provide daily data files to Owner for each days test results in a .CSV file or equivalent

10.31.3 The electronic version shall be provided in a common GIS format for further coverage analysis by Owner. The following map file formats are acceptable.

10.31.3.1 ESRI shape files
10.31.3.2 ESRI export files
10.31.3.3 MapInfo-Mif or Mid files

10.31.4 All predicted and CATP measured coverage data shall be provided as a single file for the entire coverage area and well as for each subsystem.

10.31.5 Proposer shall process this data to determine whether the coverage test passed for each equipment configuration, and to produce high resolution maps detailing the coverage test results.

10.31.6 Proposer shall submit to Owner a narrative report detailing the testing methodology, test conditions at the time of testing and coverage test results. Proposer shall also provide BER and signal strength maps for both mobile and portable radios based on the signal strength measurements taken during the drive test.

10.31.6.1 60 Day Operational Test
10.31.6.2 Final System Acceptance

10.32 Microwave Factory Acceptance Test

10.32.1 The system factory staging and factory acceptance test process is intended to ensure that all microwave and MPLS system components have been properly configured and integrated prior to the field delivery of system components. Staging provides an opportunity for the system Proposer to resolve any technical issues while located in a controlled environment with ready access to factory engineering support and manufacturing resources.
10.32.2 Inclusion of the factory staging process is required as a part of the response to this RFP and should be indicated on the Proposal schedule. Owner reserves the right to request specific tests to be performed as it sees fit during the factory acceptance test, including the rerunning of specific tests if deemed necessary by Owner.

10.32.3 Prior to Factory Acceptance Test, Contractor manufactured equipment shall be staged on the factory floor and connections shall be made to simulate network connections and system layout per the Owner system design. RF transmission measurements are conducted between radio hops. TDM channels and/or Ethernet channels shall be provisioned per the microwave and MPLS network design and each channel shall be tested to system design specifications using calibrated test equipment. Contractor staff shall perform the tests as outlined. All testing shall be fully witnessed by Owner representatives.

10.33 Inspection of Microwave and MPLS Equipment

10.33.1 Owner shall perform 100% inspection of all staged Owner microwave and MPLS equipment. This inspection process verifies that all equipment is configured and installed in a craftsman-like manner in accordance with the detailed design.

10.34 Supplied Measurements and Tested Measurements of Performance Values

10.34.1 All supplied equipment shall have been tested prior to arrival of Owner representatives at the factory location. All test results shall be provided in electronic and printed form.

10.34.2 While witnessed by Owner personnel, portions of the supplied system shall be tested for performance. This test demonstrates that the system performs to manufacturer equipment specifications by examination of sample test data. System levels shall be tested at a level of 5% sampling of all infrastructure elements by Proposer and all values made available for Owner review.

10.35 Functional Acceptance Testing

10.35.1.1 Factory staging shall also include customer review of system operation and basic functional testing. This structured test demonstrates that all equipment features perform as specified in the Proposal, the system design and manufacturer’s specification documents.

10.35.2 Test Activities

10.35.2.1 Perform Visual Inspection of all Equipment

10.35.2.2 Inventory all Equipment

10.35.2.3 Review all installed Software Versions for Microwave Equipment and MPLS Equipment

10.35.2.4 Review of 100% of Previously Measured System Performance Data

10.35.2.5 Measure all Transmitter and Receive Frequencies (5% of equipment, selected at random by Owner)

10.35.2.6 Measure all Transmitter Power Output at Top of Rack (5% of equipment, selected at random by Owner)

10.35.2.7 Measure Receiver Sensitivity and AGC Thresholds at Top of Rack (5% of equipment, selected at random by Owner)
10.35.2.8 Demonstrate MHSB Switching
10.35.2.9 Verify all End-to-End Circuit Assignments and Circuit Continuity at all Sites
10.35.2.10 Perform Overnight BER Test / Confirm Overnight BER Testing Results
10.35.2.11 Exercise and Confirm Operation of T-1 Loop Protection Switching Equipment with Measurement of End-to-End Delay
10.35.2.12 Simulate Path Fade below Threshold and Recovery
10.35.2.13 Generate Radio, Interface and MPLS Equipment Failures and Observe Fail Over for MHSB Radios and Equipment Recovery
10.35.2.14 Test Ethernet Throughput Using Highest Design Rate for each Hop
10.35.2.15 Demonstrate Operation of MPLS Router and Switch
10.35.2.16 Demonstrate Operation of Configuration and Microwave Network NMS
10.35.2.17 Demonstrate MPLS Provisioning NMS
10.35.2.18 Demonstrate System Diagnostic Capabilities, Alarm Reporting and Site Control Outputs
10.35.2.19 Demonstrate Craft Interface
10.35.2.20 Demonstrate Radio Failure Reporting to NMS

10.36 Detailed Microwave and MPLS Testing Requirements

10.36.1 Prior to the start of the test process, the system shall be set up as a single, completely interconnected and configured system including all radios, multiplexers, and NMS equipment as specified by the Owner system design.

10.36.2 The RFC2544 Throughput Test method shall be used for evaluating the transfer performance of the equipment. Throughput is a measure of how many input frames the network equipment can transfer without dropped frames. Throughput is measured by inputting frames to the device under test (DUT) at a known rate and checking whether or not the transferred frames are lost. The input frame rate is changed to measure the maximum rate at which frames can be transferred without loss.

10.36.3 Acceptance testing shall test Ethernet latency, jitter, and failover/recovery with full traffic load and 1500 byte packets. Testing shall include simulated Owner worst-case hop system conditions for hop-to-hop fade margins. End-to-end BER measurements shall be made with full load and 1500 byte Ethernet packets.

10.36.4 Demonstrate actual system equipment operation with various staged fault conditions of the operating NMS, radios and multiplexers. Each alarm-generating test shall be verified to produce a corresponding alarm on the NMS and the craft interface terminal.

10.37 Network BER Testing

10.37.1 The residual BER test shall be made under no-fade conditions, with the path attenuated to the lowest predicted signal level, for the worst hop of the Owner microwave network, per the Contractor microwave network design. The test period shall be for a minimum of 12 hours with BER not to exceed the test objective of Nx10E-12, where “N” is equal to the number of radio hops. This shall be a bi-directional test.
10.38 **Internet Protocol Wide Area Network Test**

10.38.1 Confirm the correct and functional Internet Protocol (IP) address is assigned to every wide area network interface.

10.38.2 Verify Internet Gateway Protocol (IGP) operation. Confirm that every Subnet is Reachable.

10.38.3 Verify IGP convergence time by shutting down some link within the loop. Bidirectional Forwarding Detection (BFD) fault detection and Open Shortest Path First (OSPF) timers shall be optimized to provide a convergence time within 800ms.

10.38.4 Verify performance target for each connection or circuit as follows:

- **10.38.4.1** End to End delay target for each connection: <8ms
- **10.38.4.2** Max jitter target for each connection: <10ms

10.39 **Label Switched Path (LSP) Recovery**

10.39.1 Verify Traffic Rerouting over MPLS network during a loss of a physical microwave link.

10.40 **Multiprotocol Label Switching (MPLS) Wide Area Network (WAN) Testing**

10.40.1 Verify Multiprotocol Label Switching (MPLS) Operation by Confirming proper Label Distribution Protocol (LDP) Neighbors are up at Each Node tested.

10.40.2 Verify Virtual Private LAN Service (VPLS) connectivity for Paging and County Radio Systems can communicate at all sites via layer 2.

10.40.3 Verify that all Virtual Local Area Network (VLAN) tag and priority tag traffic remains tagged in a pass-through scenario.

10.40.4 Verify that all Virtual Local Area Network (VLAN) tag and priority tag traffic remains tagged in an Ethernet over Multiprotocol Label Switching (EoMPLS) Layer 2 Tunnel pass-through scenario.

10.40.5 Confirm that Quality of Service (QoS) configurations are functioning per network design using, Quality of Service (QoS), Type of Service (TOS), and Multiprotocol Label Switching (MPLS) experimental bits (EXP) bits.

10.40.6 Verify that the proper bandwidth is allowed under fully loaded traffic congestion using Smart Bit or Ixia Internet Protocol packet generator. No packet assign to the priority queue should be drop in a congestion situation.

10.40.7 Measure and document packet jitter for paging and county radio system traffic under no congestion and fully congestion scenario. Fully congestion scenario can be defined as the WAN interface is at throughput capacity.

10.40.8 Conduct Network Connectivity Tests, Including Ping and Loopback Tests, Route Tracing to Verify Hop Count/Network Connectivity and Packet Traces.

10.40.9 Verify OSPF Neighbor Adjacency, Session Statistics and MPLS Router Configurations.
10.41 Test Failures

10.41.1 In the event that any component should fail during factory acceptance testing, or fail to meet the criteria specified to pass a specific test:

10.41.1.1 Where a failed component can be immediately replaced, it shall be replaced with new equipment and testing shall continue as per the test procedure. If a failure occurs during overnight BER test, an additional day may be added to the test process.

10.41.1.2 If a system test should fail, factory engineers shall be given an opportunity to remedy the problem. A re-test shall then be performed. If a failure occurs during overnight BER test, an additional day may be added to the test process.

10.42 Submission of Factory Acceptance Test Plan Documentation Samples

10.42.1 Proposer shall submit a sample acceptance test plan which includes these required elements with their Proposal. This acceptance test plan shall define the tests to be performed by the Proposer for each phase of the Acceptance Test to verify that the system performs in accordance with contract specifications. Where specified, the test results shall reflect both quantitative and qualitative data, not just pass/fail determination.

10.42.2 Proposers shall detail their understanding of how this process shall be conducted, detail deliverables, and identify any associated costs. A final Acceptance Test Plan shall be developed during the detailed design review process.

10.43 Microwave Field Acceptance Test

10.43.1 Including a factory staging process shall be required as a part of the response to this RFP and shall be indicated on the Proposal schedule. Owner reserves the right to request specific tests to be performed as it sees fit during the factory acceptance test, including the rerunning of specific tests if deemed necessary by Owner.

10.43.2 Prior to Field Acceptance Test, Contractor manufactured equipment shall be installed in the field per the system layout in the Owner system design. RF transmission measurements are conducted between radio hops. TDM channels and/or Ethernet channels shall be provisioned per the microwave and MPLS network design and each channel shall be tested to system design specifications using calibrated test equipment.

10.44 Inspection of Microwave and MPLS Equipment

10.44.1 Owner shall perform 100% inspection of all installed Owner microwave and MPLS equipment. This inspection process verifies that all equipment is configured and installed in a craftsman-like manner in accordance with the detailed design.

10.45 Supplied Measurements and Tested Measurements of Performance Values

10.45.1 All supplied equipment shall have been tested to manufacturer specifications. All test results shall be provided in electronic and printed form. The supplied system shall be tested for performance. System levels shall be tested at a level of 100% of all infrastructure elements by Proposer and all values made available for Owner review. Contractor staff shall perform the tests as outlined. All testing may be fully witnessed by Owner representatives.
10.46 Functional Acceptance Testing

10.46.1 Field Acceptance shall also include complete customer review of system operation and basic functional testing. This structured test demonstrates that all equipment features perform as specified in the Proposal, the system design and manufacturer's specification documents.

10.47 Test Activities

10.47.1 Perform Visual Inspection of all Equipment
10.47.2 Review of Contractor Inventory all Equipment
10.47.3 Review all Installed Software Versions for Microwave Equipment and MPLS Equipment
10.47.4 Review of 100% of Previously Measured System Performance Data
10.47.5 Measure all Transmitter and Receive Frequencies (100% of equipment, selected witnessing of measurements at random by Owner)
10.47.6 Measure all Transmitter Power Output at Top of Rack (100% of equipment, selected witnessing of measurements at random by Owner)
10.47.7 Measure Receiver Sensitivity and AGC Thresholds at Top of Rack (100% of equipment, selected witnessing of measurements at random by Owner)
10.47.8 Verify all End-to-End Circuit Assignments and Circuit Continuity at all Sites
10.47.9 Review of BER Test Results
10.47.10 Exercise and Confirm Operation of T-1 Loop Protection Switching Equipment
10.47.11 Simulate Path Fade below Threshold and Recovery
10.47.12 Generate Radio, Interface and MPLS Equipment Failures and Observe Fail Over for Monitored Hot Standby (MHSB) Radios and Equipment Recovery
10.47.13 Test Ethernet Throughput Using Highest Design Rate for each Hop
10.47.14 Demonstrate Operation of MPLS Router and Switch
10.47.15 Demonstrate Operation of Configuration and Microwave Network NMS
10.47.16 Demonstrate MPLS Provisioning NMS
10.47.17 Demonstrate System Diagnostic Capabilities, Alarm Reporting and Site Control Outputs
10.47.18 Demonstrate Craft Interface
10.47.19 Demonstrate Radio Failure Reporting to NMS

10.48 Detailed Radio Testing Requirements

10.48.1 Prior to the start of the test process, the system shall be set up as a single, completely interconnected and configured system including all radios, multiplexers, and NMS equipment as specified by the Owner system design.

10.48.2 The RFC2544 Throughput Test method shall be used for evaluating the transfer performance of the equipment. Throughput is a measure of how many input frames the network equipment can transfer without dropped frames. Throughput is measured by inputting frames to the device under test (DUT) at a known rate and checking whether or not the transferred frames are lost. The input frame rate is
changed to measure the maximum rate at which frames can be transferred without loss.

10.48.3 Acceptance testing shall test Ethernet latency, jitter, and failover/recovery with full traffic load and 1500 byte packets. Testing shall include simulated Owner worst-case hop system conditions for hop-to-hop fade margins. End-to-end BER measurements shall be made with full load and 1500 byte Ethernet packets.

10.48.4 Demonstrate actual system equipment operation with various staged fault conditions of the operating NMS, radios and multiplexers. Each alarm-generating test shall be verified to produce a corresponding alarm on the NMS and the craft interface terminal.

10.49 Network BER Testing

10.49.1 The residual BER test shall be made under no-fade conditions, with the path attenuated to the lowest predicted signal level, for the worst hop of the Owner microwave network, per the Contractor microwave network design. The test period shall be for a minimum of 12 hours with BER not to exceed the test objective of Nx10E-12, where “N” is equal to the number of radio hops. This shall be a bi-directional test.

10.50 Internet Protocol Wide Area Network Test

10.50.1 The correct and functional Internet Protocol (IP) address shall be assigned to every wide-area network interface. Verify MPLS Operation by Confirming proper LDP Neighbors are up at Each Node

10.50.1.1 Verify Internet Gateway Protocol (IGP) operation. Confirm that every Subnet is Reachable

10.50.1.2 Verify IGP convergence time by shutting down some link within the loop. Bidirectional Forwarding Detection (BFD) fault detection and Open Shortest Path First (OSPF) timers shall be optimized to provide a convergence time within 800ms

10.50.1.3 Verify performance target for each connection or circuit

10.50.1.3.1 End to End delay target for each connection: <8ms

10.50.1.3.2 Max jitter target for each connection: <10ms

10.51 Label Switched Path (LSP) Recovery

10.51.1 Verify Traffic Rerouting over MPLS network during a loss of a physical microwave link

10.52 Multiprotocol Label Switching (MPLS) Wide Area Network (WAN) Testing

10.52.1 Multiprotocol Label Switching (MPLS) Operation shall be tested by confirming proper Label Distribution Protocol (LDP) Neighbors are up at Each Node tested.

10.52.1.1 Verify Virtual Private LAN Service (VPLS) connectivity for Paging and County Radio Systems can communicate at all sites via layer 2

10.52.1.2 Verify that all Virtual Local Area Network (VLAN) tag and priority tag traffic remains tagged in a pass-through scenario.

10.52.1.3 Verify that all Virtual Local Area Network (VLAN) tag and priority tag traffic remains tagged in an Ethernet over Multiprotocol Label Switching (EoMPLS) Layer 2 Tunnel pass-through scenario.
10.52.2 Confirm that Quality of Service (QoS) configurations are functioning per network design using, Quality of Service (QoS), Type of Service (TOS), and Multiprotocol Label Switching (MPLS) experimental bits (EXP) bits.

10.52.2.1 Base on Verify that the proper bandwidth is allowed under fully loaded traffic congestion using Smart Bit or Ixia Internet Protocol packet generator. No packet assign to the priority queue should be drop in a congestion situation.

10.52.2.2 Measure and document packet jitter for paging and county radio system traffic under no congestion and fully congestion scenario. Fully congestion scenario can be defined as the WAN interface is at throughput capacity.

10.52.2.3 Conduct Network Connectivity Tests, Including Ping and Loopback Tests, Route Tracing to Verify Hop Count/Network Connectivity and Packet Traces

10.52.2.4 Verify OSPF Neighbor Adjacency, Session Statistics and MPLS Router Configurations

10.53 Test Failures

10.53.1 In the event that any component should fail during factory acceptance testing, or fail to meet the criteria specified to pass a specific test:

10.53.1.1 Where a failed component can be immediately replaced, it shall be replaced with new equipment and testing shall continue as per the test procedure. If a failure occurs during overnight BER test, an additional day may be added to the test process.

10.53.1.2 If a system test should fail, factory engineers shall be given an opportunity to remedy the problem. A re-test shall then be performed. If a failure occurs during overnight BER test, an additional day may be added to the test process.

10.54 Submission of Factory Acceptance Test Plan Documentation Samples

10.54.1 Proposer shall submit a sample acceptance test plan which includes these required elements with their Proposal. This acceptance test plan shall define the tests to be performed by the Proposer for each phase of the Acceptance Test to verify that the system performs in accordance with contract specifications. Where specified, the test results shall reflect both quantitative and qualitative data, not just pass/fail determination. Proposers shall detail their understanding of how this process shall be conducted, detail deliverables, and identify any associated costs. A final Acceptance Test Plan shall be developed during the detailed design review process.
11 TRAINING PROGRAM REQUIREMENTS

11.1 Training Program Overview

11.1.1 Proposers shall include a full package of training programs suitable for each and every of their system elements, including radio system infrastructure, radio subscriber equipment, microwave and MPLS network. Proposers shall include the cost of all training in the Proposal.

11.1.2 The Proposer shall provide a description of all training required for Owner personnel on the operation and maintenance of all equipment provided with the radio system. This training shall be specifically tailored to the configuration of the PSERN and subscriber equipment. Training for third party systems and equipment shall also be clearly identified and all costs included. All initial training shall be based on instructor led, live training. Owner also requires supplemental computer based training system for training refresh.

11.1.3 The Proposer shall define, based upon the specific training being performed, the pre-requisite knowledge level typically required for a trainee to successfully complete the course. The Proposer shall provide a description of each course including the material to be covered and number of hours or days of training per course.

11.2 Technician Training

11.2.1 Training shall be provided to technical staff at the Contractor training facility

11.2.2 Technical training shall provide direct training for system managers, system administrators and technicians who support each of the proposed systems

11.2.3 Group size for factory shall be smaller groups of approximately 3-5 per session. Multiple sessions may be required

11.2.4 Training shall take place no more than 45 days before Factory Test

11.2.5 Additional ‘cycles’ of technicians shall be trained in the period following Factory Test

11.2.6 All training material shall be provided in electronic form. With the exception of complex system manuals, class materials shall also be provided in printed form

11.2.7 All provided training materials shall be customizable electronic media and shall be for use at the Owner’s discretion.

11.2.8 Subcontractors for installation or post-sale support shall be trained appropriately and such training shall not be a part of the training required by this section. Training of subcontractor personnel shall not be a part of the Proposer training described in this section. All costs for such training shall be borne solely by the Proposer

11.2.9 PSERN equipment shall not be used for training purposes

11.3 “Train-the-Trainer” (TTT) Training for Dispatch Centers and Subscriber Equipment

11.3.1 Agency training staff shall be selected to participate in TTT training. Training class materials shall be such that they may be easily used for training end users of the dispatch consoles and subscriber radio equipment.
11.3.2 In addition to the training class, Proposers shall provide end-user training materials that are suited for use as PowerPoint presentations or videos, without extensive customization by Owner trainers.

11.3.3 Training shall be provided to all groups in King County, Washington.

11.3.4 A train-the-trainer approach shall be used for non-technical training.

11.3.5 Group size shall be approximately 10-20 personnel per classroom.

11.3.6 Space for classes shall be provided by the Owner.

11.3.7 All training material shall be provided in electronic form. With the exception of complex system manuals, class materials shall also be provided in printed form.

11.3.8 All training materials shall become the sole property of the Owner and may be used for training purposes without restriction.

11.3.9 Subcontractors for installation or post-sale support shall be trained appropriately and such training shall not be a part of the training required by this section. Training of subcontractor personnel shall not be a part of the Proposer training described in this section. All costs for such training shall be borne solely by the Proposer.

11.4 **Management Training System and Technical Manager Training**

11.4.1 Proposers shall provide required training to System Managers, System Administrators and other Technical Managers and support staff, as required.

11.4.2 The provided classes shall be structured such that Owner staff may easily attend the classes and develop an understanding of the technologies and systems in a progressive manner, starting from basic concepts and building to a full understanding of all system elements.

11.4.3 The following sections describe some, but not all, technical manager and technologist training elements expected as part of the PSERN deployment process.

11.4.4 **Radio System Infrastructure and Network Management System (NMS) Training** –
Training Technical staff shall be required to support the proposed radio system solution. Owner personnel shall be trained on the configuration, optimization, operations and maintenance of the radio system hardware as well as the radio system NMS. Proposers should provide details on the required training. Classes should include theory reinforced by significant hands-on experience.

11.4.5 Course content shall include, but not limited to:

11.4.5.1 Technology and capability overview training of Project 25 conventional and trunked radio systems and interoperability technology

11.4.5.2 P25 digital radio system theory and performance

11.4.5.3 Radio product and system descriptions

11.4.5.4 Installation procedures and practices

11.4.5.5 Individual component product and system configuration procedures

11.4.5.6 Configuration, turn-on, alignment, database backup and management, system software updates, and testing procedures

11.4.5.7 Diagnostic and fault identification procedures
11.4.5.8 Unit replacement procedures, including discussion of hot swap procedures
11.4.5.9 Operating, RF exposure safety, and operational continuity procedures
11.4.5.10 Preventative maintenance processes

11.4.6 Console Hardware and Console Network Management System (NMS) Training
- Technical staff shall be required to support the proposed dispatch console solution. Owner personnel shall be trained on the configuration, optimization, operations and maintenance of the dispatch console hardware as well as the NMS. Proposers should provide details on the required training. Classes shall include theory reinforced by significant hands-on experience.

11.4.7 Proposers shall provide all required training classes intended for the Proposal dispatch console system and network management system(s). The provided classes shall be structured such that Owner staff may easily attend the classes and develop an understanding of the technologies and systems in a progressive manner, starting from basic concepts and building to a full understanding of all system elements.

11.4.8 Course content shall include, but not limited to:
11.4.8.1 Console product and system descriptions
11.4.8.2 Installation procedures and practices
11.4.8.3 Individual component product and system configuration procedures
11.4.8.4 Turn-on and testing procedures
11.4.8.5 Diagnostic and fault identification procedures
11.4.8.6 Unit replacement procedures
11.4.8.7 Operating and operational continuity procedures

11.4.9 IP Logging Recorder Hardware and Recorder Management System (RMS) Training
- Technical staff shall be required to support the proposed IP recorder solution. Owner personnel shall be trained on the configuration, optimization, operations and maintenance of the IP logging recorder hardware as well as the RMS. Proposers should provide details on the required training. Classes shall include theory reinforced by significant hands-on experience.

11.4.10 Proposers shall provide all required training classes intended for the Proposal IP logging recorder system and network management system(s). The provided classes shall be structured such that Owner staff may easily attend the classes and develop an understanding of the technologies and systems in a progressive manner, starting from basic concepts and building to a full understanding of all system elements.

11.4.11 Course content shall include, but not limited to:
11.4.11.1 Recorder product and system descriptions
11.4.11.2 Installation procedures and practices
11.4.11.3 Individual component product and system configuration procedures
11.4.11.4 Turn-on testing procedures
11.4.11.5 Diagnostic and fault identification procedures
11.4.11.6 Unit replacement procedures, including discussion of hot swap procedures

11.4.11.7 Operating and operational continuity procedures

11.4.12 **Subscriber Hardware and Programming Software Training** - Technical staff shall be required to support the proposed subscriber radios. Owner personnel shall be trained on the configuration, optimization, operations and maintenance of the subscriber radio hardware as well as radio programming software. Proposers shall provide details on the required training. Classes shall include theory reinforced by significant hands-on experience.

11.4.13 Proposers shall provide all required training classes intended for the Proposal subscriber radio hardware and radio programming software. The provided classes shall be structured such that Owner staff may easily attend the classes and develop an understanding of the technologies and systems in a progressive manner, starting from basic concepts and building to a full understanding of all system elements.

11.4.14 Course content shall include, but not limited to:

11.4.14.1 Radio product and system descriptions
11.4.14.2 Installation procedures and practices
11.4.14.3 Individual component product and system configuration procedures
11.4.14.4 Repair, alignment and testing procedures
11.4.14.5 Diagnostic and fault identification procedures
11.4.14.6 Operating procedures

11.4.15 **Subscriber Radio Optimization** - Technical staff shall be trained on all aspects of optimizing a radio subscriber for desired operation on the PSERN. This training shall specifically cover the important aspects of network and other configurable radio parameters that ultimately affect the roaming and site affiliation behavior of a subscriber radio on the PSERN. The training shall include an overview of roaming methodology and optimizing radio roaming given the topology and topography of the PSERN.

11.4.16 **Microwave Network Hardware and Microwave NMS Training** - Technical staff shall be required to support the proposed microwave network hardware and NMS. Owner personnel shall be trained on the configuration, optimization, operations and maintenance of the subscriber radio hardware as well as radio programming software. Proposers should provide details on the required training. Classes should include theory reinforced by significant hands-on experience.

11.4.17 Proposers shall provide all required training classes intended for the Proposal microwave hardware and NMS. The provided classes shall be structured such that Owner staff may easily attend the classes and develop an understanding of the technologies and systems in a progressive manner, starting from basic concepts and building to a full understanding of all system elements.

11.4.18 Course content shall include, but not limited to:

11.4.18.1 Digital transmission theory
11.4.18.2 Microwave product and system descriptions
11.4.18.3 Installation procedures and practices
11.4.18.4 Product and system configuration procedures
11.4.18.5 Turn-on, alignment and testing procedures
11.4.18.6 Diagnostic and fault identification procedures
11.4.18.7 Unit replacement procedures, including discussion of hot swap procedures
11.4.18.8 Operating, RF exposure safety, and traffic continuity procedures

11.4.19 MPLS Hardware and MPLS NMS Training - Technical staff shall be required to support the proposed MPLS switching system hardware and NMS. Owner personnel shall be trained on the configuration, optimization, operations and maintenance of the MPLS hardware as well as NMS. Proposers shall provide details on the required training. Classes shall include theory reinforced by significant hands-on experience.

11.4.20 Proposers shall provide all required training classes intended for the Proposal subscriber MPLS hardware and NMS. The provided classes shall be structured such that Owner staff may easily attend the classes and develop an understanding of the technologies and systems in a progressive manner, starting from basic concepts and building to a full understanding of all system elements.

11.4.21 Course content shall include, but not limited to:

11.4.21.1 IP network and MPLS switching theory
11.4.21.2 MPLS product and system descriptions
11.4.21.3 Installation procedures and practices
11.4.21.4 Product and system configuration procedures
11.4.21.5 Turn-on, alignment and testing procedures
11.4.21.6 Diagnostic and fault identification procedures
11.4.21.7 Unit replacement procedures, including discussion of hot swap procedures
11.4.21.8 Operating and traffic continuity procedures

11.4.22 DC Power Systems and Network Management System (NMS) Training - Technical staff shall be required to support the proposed DC power systems hardware and NMS. Owner personnel shall be trained on the configuration, optimization, operations and maintenance of the DC power system hardware and NMS. Proposers should provide details on the required training. Classes shall include theory reinforced by significant hands-on experience.

11.4.23 Proposers shall provide all required training classes intended for the Proposal DC power systems hardware and NMS. The provided classes shall be structured such that Owner staff may easily attend the classes and develop an understanding of the technologies and systems in a progressive manner, starting from basic concepts and building to a full understanding of all system elements.

11.4.24 Course content shall include, but not limited to:

11.4.24.1 Power system product and system descriptions
11.4.24.2 Installation procedures and practices
11.4.24.3 Product and system configuration procedures
11.4.24.4 Turn-on, adjustment and testing procedures
11.4.24.5 Diagnostic and fault identification procedures
11.4.24.6 Unit replacement procedures, including discussion of hot swap procedures
11.4.24.7 Operating, safety, and traffic continuity procedures

11.4.25 Manufacturer Site Standards and Quality Management Training - Owner personnel shall be trained in proper radio site practices. Proposers shall provide details on the required training.

11.4.26 Proposers shall provide all required training classes required for Owner technical staff to fully understand proper radio site practices. The provided classes shall be structured such that Owner staff may easily attend the classes and develop an understanding of the requirements for proper site power, grounding, environmental control and related systems in a progressive manner, starting from basic concepts and building to a full understanding of all elements.

11.4.27 Course content shall include, but not limited to:

11.4.27.1 Need for site standards, as well as national, state, local codes and manufacturer standards
11.4.27.2 Radio site standards for power, grounding and other relevant systems
11.4.27.3 Equipment installation procedures and practices
11.4.27.4 Product and system configuration procedures
11.4.27.5 Testing procedures for site systems
11.4.27.6 Diagnostic and fault identification procedures
11.4.27.7 RF exposure safety

11.4.28 User Training - Proposers shall provide all required training classes intended for their proposed radio system solution. The provided classes shall be structured such that Owner agency staff may easily attend the classes and develop an understanding of the technologies, systems and most importantly, operations of those systems, in a progressive manner, starting from basic concepts and building to a full understanding of all elements. The following sections describe some, but not all, the user agency training elements expected as part of the PSERN deployment process.

11.4.29 Dispatcher Operator Training - Dispatch center training personnel shall be trained on the operations and high level maintenance of the dispatch console hardware and software. This training shall include use of customized console configurations based on the specific final design of the PSERN. Training in the use of back-up control stations is also required.

11.4.30 Logging Recorder Training - Dispatch center training personnel shall be trained in the operation of the IP logging recorder client workstation.

11.4.31 Subscriber Radio User Training - User agency personnel shall be trained on the operations of each and every model of the proposed mobile, portable and control station hardware. This training shall include use of customized radio configurations based on the specific final design of the PSERN.
11.4.32 Site Transmitter Combining Systems and Antenna System Training - The Proposer shall provide training to Owner technical staff on all facets of operation, configuration and maintenance of site receiver multicoupler and tower top amplifier equipment (if proposed and implemented in PSERN).

11.4.33 Proposers shall provide all required training classes for Owner technical staff to fully understand proper transmitter combiner system tuning, and aspects of Peak Instantaneous Power (PIP) inherent in TDMA systems.

11.4.34 System Test and Analysis Equipment - The Proposer shall provide local classroom Owner personnel training on the configuration and operation of all offered test equipment outlined in the RFP.

11.4.35 Proposers should provide details on the required training agenda, however, as a minimum the classes content shall include theory reinforced by significant hands-on experience. Training shall utilize the same make and model of test equipment offered. The Owner-procured test equipment shall be issued prior to training for students to train on their own issued equipment.

11.4.36 Test equipment training shall be provided on the following equipment and systems:

11.4.36.1 P25 Communications Analyzer
11.4.36.2 Microwave Test Equipment
11.4.36.3 Passive Intermodulation (PIM) Testing Equipment
11.4.36.4 Mobile RF Direction Finding (DF) Equipment
11.4.36.5 Fiber Optic Test Equipment
11.4.36.6 STI Coverage Test Packages with Receivers (Qty. 2)
11.4.36.7 Other Vendor Recommended Test Equipment
12 TRANSITION PLAN REQUIREMENTS

12.1 Transition Plan Overview

12.1.1 King County including Seattle, City of Bellevue and Seattle-Tacoma International Airport, represents a major metropolitan center with a high population density and very large industrial, civil aviation and military presence. The major intersection of regional transportation arterials (I-5 and I-90) provides the foundation for local commerce, international commerce to Canada and commerce throughout the Inter-Mountain region.

12.1.2 Added to this is the fact that the region sits upon a known major geologic fault zone with the potential for significant localized natural disasters encompassing earthquake, tsunami, volcanic eruption and lahar flow. Due to the extremely large DOD presence, aviation and software R&D and seaport access, King County is also at a higher risk for terrorism-related events than other regions of the country.

12.1.3 King County First Responders have a significant mission ensuring the safety of the public and protection of the region from a wide spectrum of potential events. Ensuring continuous radio communications operations during the transition phase of the PSERN project cannot be overemphasized.

12.1.4 The installation, optimization and cutover from the existing Owner regional analog trunked radio system to the proposed P25 digital trunked radio replacement system represents a complex project from both a logistical and technical standpoint. Owner wishes to ensure that disruption to live public safety communications and the impact to both dispatch and field personnel are mitigated to the greatest possible extent.

12.1.5 The Proposer shall outline a comprehensive transition strategy to the Owner that allows the existing Owner regional radio system and existing microwave network to remain functional to the greatest extent possible through system transition without significant loss of dispatch and radio user communications capability. Transition plans that include the reuse of existing 800 MHz radio spectrum shall detail the methodology to be used for the transition process in the Proposal.

12.2 Continuity of Operations in Transition Plan

12.2.1 The Proposer shall ensure uninterrupted operability between the proposed and existing radio systems during the transition period.

12.2.2 During the entire implementation and transition period, end users shall maintain the ability to communicate using normal and interoperability talk groups.

12.2.3 Use and issue of multiple portable subscriber radios as a transition strategy is unacceptable.

12.2.4 Use and issue of multiple mobile subscriber radios as a transition strategy is unacceptable.

12.2.5 Use and issue of multiple dispatch consoles per operator position as a transition strategy is unacceptable.

12.3 Transition Plan Logistical Concerns

12.3.1 Existing site facilities have finite limits regarding shelter space, heating and cooling load capacity, floor loading, AC utility service, load panel power capacity and tower loading constraints. During the transition period two systems may need to operate in parallel while sharing limited resources within a common facility. The
12.4 Transitional Functionality

12.4.1 It may be acceptable for some other trunking features to be limited during transition as described in Section 4. Proposer shall describe how the transition strategy would provide continuous end user communications capability and provide a detailed overview of the features or functionality that would be limited during transition.

12.4.2 The following are required minimal functionality through the transition process:

12.4.2.1 Audio shall pass between the existing and the PSERN

12.4.2.2 Emergency signaling shall be provided over each network. Emergency indications shall pass between systems.

12.4.2.3 Unit ID signaling shall be provided over each network. Unit ID’s shall pass between systems.

12.4.3 The actual timeframe for the transitions of individual systems and for the transitions of individual end-user agencies shall be of limited and predictable durations to minimize impacts on both system owner/operators and on end-user agencies. Proposers shall clearly define the period of transition required for their specific solution(s).

12.4.4 Gateways may be required for continuous operability between the two systems during the transition process. Aggressive spectrum management may be required to accommodate the day-to-day operation for each group of users while they are being transitioned from the legacy system to new system.

12.4.5 Proposers shall clearly indicate the means and methods by which the proposer plans to transition the existing subscriber base of over 16,000 radios from the present Motorola 4.1 SmartZone™ system to the PSERN. This transition process could involve the patching of up to several hundred talkgroups during phases of the transition process. Proposers shall include the equipment and services required to implement this change in the Proposal. Potential means of accomplishing this cutover process include use of:

12.4.5.1 4 Wire interface based patches - The present Motorola system still maintains a number of console locations where 4 wire interfaces to talkgroups on the present system are available.

12.4.5.2 Use of ISSI interconnections– The present system is equipped with ISSI.1 interface capability. These could be provisioned to add capacity that would allow use of basic ISSI to ISSI linkages

12.4.5.3 Hard cutover – Where the new system is available for operation and user agencies make a rapid transition from the existing system to the new PSERN

12.4.5.4 Other methods

12.4.6 Proposer shall detail a transition strategy that takes into account the operational, technical and logistical challenges in the execution of the system transition. The transition strategy plan and outline shall include as a minimum, the following components:
12.4.6.1 Site equipment, antenna and feedline, and radio spectrum cutover strategies
12.4.6.2 Microwave equipment, antenna/feedline and microwave spectrum cutover strategies
12.4.6.3 Network transport cut-over, including transition to new MPLS switched network from present DS3/T-1 environment
12.4.6.4 Site space management strategy
12.4.6.5 Tower loading considerations
12.4.6.6 Site AC and DC power system cutover management strategy
12.4.6.7 Dispatch console upgrade and cutover strategy
12.4.6.8 Radio subscriber fleet cutover approach (install, de-install, programming)
12.4.6.9 Site "turn up" sequencing
12.4.6.10 Is work outside of normal hours required
12.4.6.11 Define any periods of expected outages and the nature of the outage
12.4.6.12 Identify expected risks to public safety operations based on the transition plan

12.4.7 Proposals shall include Gantt charts and flowcharts to represent phases and sequencing of transition.

12.5 Cutover to New System Operations
12.5.1 The existing Owner regional radio system and existing microwave network shall remain functional to the greatest extent possible through system transition without significant loss of dispatch and radio user communications capability. The following are required minimal functionality through the transition process:
12.5.1.1 Audio shall pass between the existing and PSERN
12.5.1.2 Emergency signaling shall be provided over each network. Emergency indications shall pass between systems.
12.5.1.3 Unit ID signaling shall be provided over each network. Unit ID’s shall pass between systems.

12.5.2 Solutions that provide emergency signaling and unit ID to function simultaneously on both existing and new infrastructure is required.

12.5.3 Proposers shall develop a comprehensive series of Cutover Plans that demonstrate their strategy for transitioning the existing Owner radio system to the PSERN. Proposers are cautioned that transitions that include the reuse of existing 800 MHz radio spectrum must detail the methodology to be used for the transition process in the Proposal.

12.5.4 Multiple cutover plans are required because of the wide range of systems being replaced as part of the transition. The Cutover Plans shall be finalized working directly with Owner’s Project Manager, PSERN user agencies and departments and communications center dispatchers and supervisors. These meetings shall address how to deal with the technical and communication impact to users, and
general operational issues and planning that need to be accommodated for Owner’s various agencies.

12.5.5 The mutually agreed upon methodology for cutover shall ensure that a safe, effective and efficient transition occurs from the old radio system to the new system with minimum impact on user operations. The Cutover Plan shall detail timelines, sequence of events, resources involved, potential downtime, operational details, which departments move to the new system, and the order in which they will migrate. The Cutover Plan shall detail how communications will occur for each department during the transition process. A Cutover Plan timetable listing the chronological orders and time frames shall also be developed. The Cutover Plan shall consider, as a minimum, the following components:

12.5.5.1 Site equipment and RF system cutover (spectrum management, and tower and equipment space considerations)
12.5.5.2 Site power-management strategy (managing peak loads with both systems active)
12.5.5.3 Dispatch console upgrade and cutover
12.5.5.4 Radio subscriber fleet cutover approach (install, de-install, programming)
12.5.5.5 Site "turn up" sequencing
12.5.5.6 Other considerations not specifically included above
12.5.5.7 Work outside of normal hours (incl. late nights and weekends) when system traffic is non-peak.
12.5.5.8 Define any periods of expected outages
12.5.5.9 Define any expected risks to operations (potential service interruptions) based on the transition plan

12.5.6 The use of Gantt chart or flowcharts to represent phases and sequencing of a transition strategy is requested.

12.5.7 Proposer shall include a fall back plan should there be a need to abort the cutover and restore Owner’s operations to the legacy radio system.
13 INITIAL TWO (2) YEAR WARRANTY PERIOD MINIMUM SUPPORT REQUIREMENTS

13.1 Proposer Support for PSERN During Initial Warranty Period

13.1.1 At a minimum, the Proposer shall provide the support, maintenance, Update, Upgrade and other Work specified herein at no additional charge to the Owner during the two (2) year warranty period following Full System Acceptance.

13.2 General Requirements

13.2.1 Proposers shall provide system technical support on a 24 hour x 7 day x 365 day per year basis. This support shall be readily available by telephone, with minimal delay. Field engineer or senior technician support shall also be available to the Owner with two (2) days prior notice to Proposer.

13.2.2 Due to the system size and complexity and critical nature of the PSERN, the Owner requires real time telephone access to subject matter experts should system Equipment and Software problems be experienced at any time of the day or night.

13.2.3 As more fully described in Section 13.8 Technical Support Service, the Proposer shall provide an initial point-of-contact and escalation points-of-contact for support and service of each element of the PSERN. This technical support shall be located in the United States and reachable by telephone on a 24 hour X 7 day X 365 day per year basis.

13.2.4 Services shall include advanced repair or replacement of failed assemblies necessary for the safe operation of the PSERN. Repaired or replaced components shall ship fastest way and are subject to Proposer inventory. Suitable spares shall be purchased for local replacement of critical failed systems.

13.3 Local Support and Representation

13.3.1 In addition to telephone technical support, the Proposer shall assign a suitably qualified technical representative as its Field Activities Manager, in accordance with Contract Section 8.0, Key Personnel, whose specific purpose is to provide direct support and liaison between the Owner and the Proposer for technical and engineering level issues. This appointed liaison shall interface daily as needed between the Owner and the Proposer for all network infrastructure, dispatch console and radio subscriber unit support.

13.4 Proposers Service Facility

13.4.1 Proposers shall establish and maintain a Regional Service Center within King County that shall be capable of providing 24 x 7 x 365 emergency support for the system. The service facility shall have factory-trained and/certified, fully equipped technicians for each element of the system.

13.4.2 Only factory-trained, and/or certified, fully-equipped technicians shall be assigned to respond to problems on the system.
13.5 Severity Levels and Times to Respond/Restore/Replenish

13.5.1 Within fifteen (15) minutes after the Proposer detects or receives a report from the Owner of a failure, problem or other incident in any element of the system, the Proposer shall notify or the Owner of the factory trained service technician assigned to respond to the call. All failures shall be initially categorized as Severity 1. The Proposer may assign a lower Severity level subject to the Owner’s agreement.

13.5.2 The Proposer shall respond, restore functionality, and replace Equipment as necessary depending on the Severity of the failure in accordance with the Severity Response and Restoration Table below:

<table>
<thead>
<tr>
<th>Severity Level</th>
<th>On-Site Response Time</th>
<th>Restoration and Replacement Time</th>
<th>Definition</th>
</tr>
</thead>
</table>
| Severity 1     | Technician enroute with fifteen (15) minutes after Proposer detects or is notified of the failure | Within four (4) hours after detection or report of failure, restore full functionality, and, if Equipment is malfunctioning, install new Equipment.  
If Owner’s spare Equipment was used provide new replacement to Owner within twenty-four (24) hours after removal from Owner’s inventory. |  
• Failure of any system control equipment element  
• Any failure which results in the loss of wide area operation of one or more simulcast radio sub-systems. |
<table>
<thead>
<tr>
<th>Severity 2</th>
<th>Technician enroute within fifteen (15) minutes after Proposer detects or is notified of the failure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Within twelve (12) hours of detection or report of failure, restore full functionality, and, if Equipment is malfunctioning, install new Equipment.</td>
</tr>
<tr>
<td></td>
<td>If Owner’s spare Equipment is used, provide new replacement to Owner within twenty-four (24) hours after removal from Owner’s inventory.</td>
</tr>
<tr>
<td></td>
<td>▪ Loss of 20% or more voice talk-path capacity at any site.</td>
</tr>
<tr>
<td></td>
<td>▪ Loss of operation of any individual site that comprises a part of a simulcast subsystem or multicast site.</td>
</tr>
<tr>
<td></td>
<td>▪ Any microwave failure which causes either a loss of traffic through a path or loss of node redundancy.</td>
</tr>
<tr>
<td></td>
<td>▪ Central management failure</td>
</tr>
<tr>
<td></td>
<td>▪ Dispatch center failure impacting operations.</td>
</tr>
<tr>
<td></td>
<td>▪ Loss of connectivity of any dispatch or RF site to core network.</td>
</tr>
<tr>
<td></td>
<td>▪ Failure of central logging recording system.</td>
</tr>
<tr>
<td></td>
<td>▪ Environmental alarms, such as HVAC, DC plant, backup power, and obstruction warning.</td>
</tr>
<tr>
<td></td>
<td>▪ This level represents major issues that result in impaired or unusable sub-system, or loss of critical features from the Owner’s perspective.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Severity 3</th>
<th>Technician enroute as soon as possible after Proposer detects or is notified of the failure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Within twenty-four (24) hours of detection or report of failure, restore full functionality, and, if Equipment is malfunctioning, install new Equipment.</td>
</tr>
<tr>
<td></td>
<td>If Owner’s spare Equipment is used, provide new replacement to Owner within twenty-four (24) hours after removal from Owner’s inventory.</td>
</tr>
<tr>
<td></td>
<td>▪ Loss of less than 20% of voice talk-path capacity at any site.</td>
</tr>
<tr>
<td></td>
<td>▪ Any microwave failure or alarm which does not result in loss of traffic or redundancy.</td>
</tr>
<tr>
<td></td>
<td>▪ No more than 1 console out-of-service at any dispatch location</td>
</tr>
<tr>
<td></td>
<td>▪ Loss of any NMS workstation.</td>
</tr>
<tr>
<td></td>
<td>▪ This level represents moderate issues that limit Owner’s normal use of the system, sub-system, product, or major non-critical features from Owner’s perspective.</td>
</tr>
</tbody>
</table>

Table 13.5 Severity Response and Restoration Table

13.5.3 Notwithstanding the above provisions, the Proposer agrees that the Owner may reassign the severity of a failure by telephone or email notice and the Proposer shall respond in accordance with the Owner’s determination.

13.6 Escalation Procedures for Equipment Servicing

13.6.1 The Owner shall have the ability to escalate support issues to Proposer engineering and product support groups.

13.6.2 The Proposer shall automatically escalate support issues to Proposer engineering and product support groups, as necessary to meet the times specified in the Severity Response and Restoration Table 13.5.
13.7 Dispatch and On-Site Response Services: 24x7x365

13.7.1 Description of Service

13.7.1.1 Dispatch service is the opening, tracking and response to service requests. Service requests shall be generated by: (a) Owner’s personnel contacting the Proposer’s Technical Support telephone number or the Proposer’s Regional Service Center in King County, initiating a service request; or (b) automatically via network monitoring alerts. Local Proposer-trained on-site personnel shall respond 24x7x365.

13.7.2 Proposer Responsibilities:

13.7.2.1 Receive Ticket openings, assign a Ticket # and document each issue via Proposer’s tracking system

13.7.2.2 Assign technical resources to the Ticket#

13.7.2.3 Notify nature of failure to Owner within 15 minutes

13.7.2.4 For Severity 1 and Severity 2 failures, Proposer’s maintenance team shall coordinate with the Owner’s personnel who shall accompany the Proposer’s team on any PSERN premises; and shall arrive at the subject PSERN site within the timeline established according to the following:

13.7.2.4.1 Core Controller Locations: 1 hour from time of dispatch

13.7.2.4.2 Regional Dispatch Centers: 1 hour from time of dispatch

13.7.2.4.3 Rural King County: 2 hours from time of dispatch

13.7.2.4.4 Proposer shall remotely access PSERN within 15 minutes of dispatch to troubleshoot.

13.7.2.4.5 Allowances shall be made for added time due to air and/or sea transportation service delays or force majeure.

13.7.2.4.6 Respond, restore functionality and provide new replacements based on times in the Severity Response and Restoration Table 13.5. Allowances shall be made for added time due to force majeure.

13.7.2.4.7 Maintain virus protection software, operating system patches for any equipment that may interact with the PSERN Equipment.

13.7.3 Proposer shall perform the following on-site alongside the Owner’s personnel:

13.7.3.1 Run diagnostics on the Equipment.

13.7.3.2 Work with Owner’s personnel to replace a failed Unit or Module as determined appropriate by the Owner. The replacement Unit or Module may be taken from the Owner’s or Proposer’s inventory. The Proposer’s technician shall be responsible for returning the failed Unit or Module to the Proposer. Provide materials, tools, documentation, physical planning manuals, diagnostic/test equipment and any other requirements necessary to perform the Work.
13.7.3.3 If a Subcontractor is needed to restore the system, the Proposer's designated maintenance team shall accompany Subcontractor personnel onto any PSERN site.

13.7.3.4 Provide new, replacement Unit or Module.

13.7.3.5 Maintain and store in an easily accessible location any and all Software needed to restore all PSERN elements.

13.7.3.6 Maintain and store in an easily accessible location proper System backups.

13.7.3.7 Document Ticket resolution

13.8 **Technical Support Service**

13.8.1 Description of Service

13.8.1.1 Technical Support service provides centralized remote telephone support for technical issues that require a high level of communications systems expertise or troubleshooting on Equipment. The Proposer's Technical Support Service Operation shall be staffed with subject matter experts who specialize in the diagnosis and resolution of system performance issues. These specialist staff shall remotely access the PSERN or replicate the problem in the system laboratory to return the PSERN to full operation as quickly and efficiently as possible. When needed, the technical support staff shall provide troubleshooting guidance over the telephone and work with the local service technician or PSERN staff to produce an efficient resolution. Technical support staff shall have access to Proposer's factory engineers to provide the highest level of technical support available.

13.8.2 Proposer Responsibilities:

13.8.2.1 Respond to requests for technical support for the restoration of failed systems and diagnosis of operation problems.

13.8.2.2 Advise caller of procedure for determining any additional requirements for issue characterization, and restoration which includes providing a known fix for issue resolution when available.

13.8.2.3 Attempt remote access to the PSERN for running remote diagnostics, when possible.

13.8.2.4 Maintain communication with Proposer’s maintenance team and Owner’s technicians in the field until close of the Ticket #, as needed.

13.8.2.5 Coordinate technical resolutions with Subcontractors, as needed.

13.8.2.6 Escalate and manage support issues, including PSERN issues, to Proposer’s engineering and product groups, as applicable.

13.8.2.7 Provide configuration change support to PSERN systems that have remote access capability.

13.8.2.8 Determine, in its sole discretion, when a Ticket # requires more than the technical support services described in this subsection, and notify Owner of an alternative course of action.
13.9 Infrastructure Equipment Replacement Service

13.9.1 Description of Service

13.9.1.1 All failed Infrastructure Equipment shall be replaced with new equipment. Use of refurbished equipment as replacements shall not be acceptable.

13.9.1.2 Proposer Responsibilities:

13.9.1.2.1 Provide return material authorization (RMA) number upon Owner or Proposer's maintenance team request for Infrastructure Equipment replacement.

13.9.1.2.2 Receive malfunctioning Infrastructure Equipment from Owner or Proposer's maintenance team and document its replacement.

13.9.1.2.3 Verify that new replacement of Infrastructure Equipment is fully functional and meets the Contract's specifications.

13.9.1.2.4 Perform a module level test on all replacements of Infrastructure Equipment.

13.9.1.2.5 Perform a system level test on replacements of Infrastructure Equipment.

13.9.1.2.6 Perform a post-test after replacement by Proposer to confirm new replacements of malfunctioning Infrastructure Equipment function properly in the PSERN configuration.

13.9.1.2.7 Re-program replaced Infrastructure Equipment to original operating parameters based on PSERN templates.

13.10 System Updates

13.10.1 Description of Service

13.10.1.1 Proposer shall provide and install all Updates to the Software including the Updates more fully described in Section 13.11.

13.10.1.2 Updates shall be performed and installed by Proposer factory personnel experienced in Update deployments during the warranty period.

13.10.2 Proposer Responsibilities:

13.10.2.1 Provide Updates to all Proposer Software and when and if available, Third Party Software Updates, done in coordination with the Owner. By way of example and not limitation, System Updates include Operating Software (“OS”), application software, patches, service packs, and host-based intrusion detection sensor (IDS) signature files. Updates to Microsoft Windows shall occur at least monthly and Updates to Oracle, Sun Microsystems and Red Hat Unix/Linux OS and IDS signature files at least quarterly.
13.10.2.2 Proposer agrees to provide only Updates that have been analyzed, pre-tested, and certified in a dedicated test lab emulating PSERN configurations to ensure compatibility with PSERN.

13.10.2.3 As Updates becomes available, Proposer shall coordinate with Owner to schedule and install on PSERN.

13.11 Network Security Monitoring and Security Updates

13.11.1 Description of Services

13.11.1.1 Network security monitoring shall occur from the Proposer’s facility and shall actively manage security elements present on the PSERN, to mitigate risks associated with malware, or other cyber-attacks, whether deliberate or inadvertent.

13.11.1.2 Security analysts shall have direct and immediate access to Proposer engineers for rapid resolution and take additional steps to reduce vulnerabilities to potential attack and protect critical radio network infrastructure.

13.11.1.3 Security-related Update service in conjunction with security monitoring shall include automatic intrusion detection signatures and anti-virus Updates. To safeguard the PSERN from virus attacks, Proposer shall obtain anti-virus definitions from the commercial supplier, and pre-test them on a dedicated system with the standard supported configurations prior to making an Update available to the PSERN. Security monitoring service shall enable the Proposer to perform periodic, and when needed immediate, deployment of the latest release of anti-virus definitions and intrusion-detection sensor signature files on the PSERN network interface barrier. Proposer shall also modify intrusion sensor settings and Updates to firewall settings as necessary.

13.11.2 Monitored Elements include:

13.11.2.1 Packet Routing Network

13.11.2.2 Controllers

13.11.2.3 All Servers

13.11.2.4 Gateways

13.11.2.5 Dispatch Consoles

13.11.3 Proposer Responsibilities:

13.11.3.1 Provide dedicated connectivity through a private network connection necessary for monitoring the PSERN.

13.11.3.2 Coordinate with Owner to maintain Proposer service authentication credentials.

13.11.3.3 Perform continuous monitoring of system elements as defined in the Monitored Elements list.

13.11.3.4 Obtain anti-virus definitions for the Microsoft Windows platform, intrusion detection sensor (IDS) signatures, operating system security patches/updates, as available, from Proposer selected commercial suppliers.
13.11.3.5 Notify the Owner whenever Updates to anti-virus definitions, including third-party operating system software are available. The Contractor shall make it possible for the Owner to “pull-in” such files when the Owner deems appropriate. Contractor shall have the duty to push high priority Updates to the Owner via email or downloadable. High priority Updates are classified as Category 4 (Severe, difficult to contain) and Category 5 (very severe, very difficult to contain).

13.11.3.6 Test anti-virus definitions, intrusion detection sensor signatures for Proposer supplied IDS, operating system security patches/updates by deploying them on a dedicated test System with the standard supported configurations, which include Proposer’s then current approved cohabitated applications for current system release and three previous system releases.

13.11.3.7 Confirm that tested anti-virus definitions, intrusion detection sensor signatures for Proposer supplied IDS, and operating system security patches/updates do not degrade or compromise System functionality on dedicated test System within the standard supported configurations.

13.11.3.8 Deploy pre-tested Updates weekly to anti-virus management server and intrusion detection sensor for Proposer supplied IDS (if present on the System) upon successful completion of the weekly test cycle to be completed one week after release by commercial supplier unless an issue is detected or as determined necessary by Proposer. High-priority updates shall be made available to the Owner within 24 hours of commercial supplier release.

13.11.3.9 Release and notify Owner when operating system security patches/Updates are certified and available. Operating system security patches shall be released as available from commercial supplier and upon successful completion of test cycle or at Proposer’s discretion.

13.11.3.10 Maintain annual PSERN licenses for anti-virus definitions and intrusion detection sensor signatures for IDS supplied to Owner by Proposer with selected commercial supplier.

13.11.3.11 Apply additional support if it is determined that system faults were caused by PSERN making changes to critical system parameters.

13.11.3.12 Proposer to deploy pre-tested operating system software patches on the PSERN.

13.12 Preventive Maintenance

13.12.1 Description of Service:

13.12.1.1 Proposer shall perform Network Preventative Maintenance in accordance with approved plan. This Work shall be performed during Business Days and as scheduled with Owner.

13.12.2 Minimum Requirements for Proposer’s Preventive Maintenance Plan:

13.12.2.1 Perform quarterly, semi-annual, and annual site maintenance visits with the intent to maintain Infrastructure according to manufacturer operational specifications.
13.12.2.2 Quarterly site visits to note system performance values and full inspection of components

13.12.2.3 Semi-annual sites visits include aspects of quarterly visits plus battery checks of condition and voltage.

13.12.2.4 Annual site visits include aspects of quarterly and semi-annual visits plus full inspection of receivers, transmitters, power amplifiers, sweeps of all feedlines, antennas, combiners, tower top amplifiers (if equipped) and multicouplers with gains and losses noted, voltage and current checks on power supplies.

13.12.2.5 Notify the Owner at least ten (10) Business Days in advance of any possible PSERN downtime needed to perform this service and coordinate site access.

13.12.2.6 Physically inspect PSERN infrastructure equipment (equipment cabinets, general circuitry, fault indicators, cables, and connections).

13.12.2.7 Remove any dust, and/or foreign substances from the infrastructure.

13.12.2.8 Clean or replace filters, if applicable.

13.12.2.9 Measure, record, align, and adjust the infrastructure equipment parameters in accordance with the manufacturer's service manuals and the Rules and Regulations of the Federal Communications Commission (FCC), where applicable.

13.13 Subscriber Equipment Replacement

13.13.1 Description of Service

13.13.1.1 All failed Subscriber Equipment shall be replaced with new Equipment. Use of refurbished equipment as replacements is not acceptable.

13.13.2 Proposer Responsibilities:

13.13.2.1 Provide return material authorization (RMA) number upon Owner's request and receive failed Unit from Owner.

13.13.2.2 Provide new replacement Unit to Owner. All radio firmware in the replacement Unit shall be upgraded to the latest release for each radio product line provided it is compatible with PSERN.

13.13.2.3 Reimburse the Owner for all of its costs in accordance with Contract Section 34.

13.13.2.4 Ship replacement Subscriber Units, at is sole expense, prior to receipt of failed Subscriber Units.

13.13.3 Owner Responsibilities

13.13.3.1 Remove failed Subscriber Units from vehicles.

13.13.3.2 Ship portable and mobile Subscriber Equipment to Proposer-designated depot facility.
13.14 DC and AC Power Systems Maintenance

13.14.1 Description of Service

13.14.1.1 Power System maintenance shall be provided by Proposer to include testing of battery plants, rectifiers and inverters.

13.14.2 Proposer Responsibilities:

13.14.2.1 Test battery plants, rectifiers and inverters for proper operation and condition.

13.14.2.2 Notify the Owner of any possible PSERN downtime needed to perform this service. Owner shall authorize any scheduled PSERN downtime.

13.14.2.3 Physically inspect the power systems

13.14.2.4 Remove any dust, and/or foreign substances from the equipment.

13.14.2.5 Measure, record, align, and adjust the equipment parameters in accordance with the manufacturer’s service manuals.

13.15 System Upgrades

13.15.1 Description of Service

13.15.1.1 Prior to the commencement of Full System Acceptance test and again at three (3) months prior to the end of the two (2) year Warranty Period, the Proposer shall provide, test and install at its sole expense a System Upgrade to the latest versions of all Software and Equipment as more fully described herein and in Section 13.16. System Upgrades shall include all elements of the PSERN including all Infrastructure Equipment and Software and all Subscriber Equipment and Software.

13.15.2 Proposer shall provide the following software design and technical resources necessary to prepare for each of the System Upgrades:

13.15.2.1 Review PSERN Infrastructure audit data as needed.

13.15.2.2 Identify any additional or replacement Equipment needed to implement a System Upgrade.

13.15.2.3 Complete a plan defining the System Upgrade, Equipment requirements and installation, and impact to PSERN users.

13.15.2.4 Advise Owner of probable impact to PSERN users during the actual field implementation.

13.15.2.5 Program management support required to perform the System Upgrade.

13.15.2.6 All engineering, installation and other labor required to perform the System Upgrade.

13.15.2.7 Update all As-Built documentation to reflect all updated Equipment, configurations and Software

13.15.2.8 Provide updated information to Proposer’s system support centers that reflect the System Upgrade, Software, Equipment, and configurations.

13.15.2.9 The Proposer shall integrate, test and certify functionality and compatibility of all new versions and patches of Third Party Software then available, mitigating risk of interference to PSERN operation.
13.15.2.10 The System Upgrade services include provision, testing and installation of Software Upgrades and Equipment as follows:

13.15.2.11 Anti-Virus Definition Updates – all Updates available at the time of the Upgrade and not already installed under Sections 13.10 and 13.11.

13.15.2.12 Minor Release (patch release) – all Updates available at the time of Upgrade and not already installed under sections 13.10 and 13.11.

13.15.2.13 Major Release (system release) – Includes all Upgrades of Proposer Software and Third-Party Software available at the time of Upgrade.

13.15.2.14 Radio Subscriber Programming Software - Includes all Upgrades of Proposer Software and Third-Party Software available at the time of Upgrade.

13.15.2.15 Equipment Refresh – Replacement and installation of all new Equipment as required to support each System Upgrade and as more fully specified in Section 13.16.

13.15.2.16 Implementation Services – Technical support and operational resources such as field engineering, field activities manager, project management and local service shop resources to provide end-to-end design, testing, on-site installation and implementation and project management services as required to support System Upgrades.

13.15.3 Proposer has the following additional responsibilities:

13.15.3.1 Proposer shall provide patch releases that have been analyzed, tested, and certified in a dedicated APCO P25 test lab to ensure that they are compatible and do not interfere with PSERN functionality. Corresponding 3rd-Party software and operating system (OS) patches shall be released quarterly or as needed upon successful completion of the regular test cycle. Once a patch release has been validated as safe for deployment on the radio network, Proposer shall post it on a secure extranet site for download and deployment.

13.15.3.2 System Upgrades shall be pre-tested and certified in the Proposer's test lab. System Upgrades shall improve the PSERN functionality and operation from previous releases to include feature enhancements. System releases shall include significant new feature enhancements.

13.15.3.3 The Owner shall be granted access to prior software versions as needed for the purpose of downgrading product software to a compatible release version.

13.15.4 System Upgrades shall cover all elements of PSERN including:

13.15.4.1 Base stations
13.15.4.2 Site controllers
13.15.4.3 Comparators, Routers
13.15.4.4 LAN switches
13.15.4.5 Servers
13.15.4.6 Dispatch Consoles
13.15.4.7 Network Management Terminals
13.15.4.8 Network Fault Management products
13.15.4.9 Network security devices such as firewalls and intrusion detection sensors, and associated peripheral infrastructure software.
13.15.4.10 Radio Subscriber Unit Programming Software

13.16 Equipment Upgrades

13.16.1 The Proposer shall provide and install new Units of all Equipment as necessary to implement System Upgrades, including the following examples:

13.16.1.1 Servers
13.16.1.2 PC Workstations
13.16.1.3 Routers
13.16.1.4 LAN Switches
13.16.1.5 Gateways
13.16.1.6 P25 Packet Data Gateways
13.16.1.7 Firewalls
13.16.1.8 PC Workstations and Network Management Clients
13.16.1.9 Base Stations
13.16.1.10 Site Controllers
13.16.1.11 Dispatch Console Operator Positions
13.16.1.12 Conventional Channel Gateways
13.16.1.13 Interoperability Gateways
13.16.1.14 GPS Timing and Synchronization Equipment

13.16.2 Proposer shall provide all implementation services necessary to design, test, and install Equipment Upgrades as more fully specified in Section 13.15.2.14.
14 POST-WARRANTY SUPPORT REQUIREMENTS

14.1 Post Warranty Extended System Support / Managed Services

14.1.1 The Owner shall have responsibility for the management of the PSERN following the end of the two (2) year initial warranty period. After this period, the Owner may elect, on an annual or multiple-year basis, to purchase one or more of the services described herein at the fixed prices specified in the Price and Payment Schedule.

14.1.2 The Owner may annually choose specific service options as required to create a customized service plan to meet its specific needs.

14.1.3 At a minimum, Proposers shall price the following services for the system for an eighteen (18) year period, beginning with the end of the initial two (2) year Warranty period following Full System Acceptance.

14.2 Support Relationship between the Owner and Proposer

14.2.1 The Proposer shall provide the prices on parts, assemblies and other materials and service required to support the PSERN that are no more than those applicable to factory authorized service organizations.

14.3 PSERN Network Monitoring

14.3.1 Description of Service

14.3.1.1 Proposer shall provide the Owner with local network monitoring within King County. Monitoring shall be performed 24x7x365 with SNMP network management tools that are located in King County. The system shall provide audible, visual, email, and text alerts to local Proposer service personnel and defined Owner personnel, when a failure occurs. Local, service personnel, shall consist of a combination of Proposer and Owner technicians, and shall respond 24x7x365 to alerts from the PSERN network management. Monitoring of the system shall ensure that the Proposer and the Owner are always fully aware of the health of the systems and are quickly notified in the event of an alarm or failure.

14.3.2 Proposer Responsibilities:

14.3.2.1 Monitor events on remote Network Management Terminal
14.3.2.2 Remotely access the PSERN to perform remote diagnosis.
14.3.2.3 Create a Service/Call Ticket, as necessary. Gather information to perform the following:
   14.3.2.3.1 Characterize the issue
   14.3.2.3.2 Determine a corrective response and plan of action
   14.3.2.3.3 Assign and track the Ticket # to resolution
   14.3.2.3.4 Respond in accordance to pre-defined Response times upon receipt of Owner managed passwords required for proper access to the PSERN.
14.4 Dispatch and On-Site Response Services: 24x7x365

14.4.1 Description of Service

14.4.1.1 Dispatch service is the opening, tracking and response to service requests. Service requests shall be generated by (a) Owner’s personnel contacting the Proposer’s Technical Support telephone number or the Proposer’s Regional Service Center in King county, initiating a service request; or (b) automatically via network monitoring alerts. Local Proposer-trained on-site personnel shall respond 24x7x365.

14.4.2 Proposers shall establish and maintain a Regional Service Center within King County that shall be capable of providing 24 x 7 x 365 emergency support for the system. The service facility shall have factory-trained and/certified, fully equipped technicians for each element of the system.

14.4.3 Only factory-trained, and/or certified, fully equipped technicians shall be assigned to respond to problems and permitted to work on the system.

14.4.4 Services shall include advanced repair or replacement of failed assemblies necessary for the safe operation of the PSERN. Repaired or replaced components shall ship fastest way and are subject to Proposer inventory. Suitable spares shall be purchased for local replacement of critical failed systems.

14.4.5 Proposer Responsibilities:

14.4.5.1 Receive Ticket openings, assign a Ticket# and document each issue via Proposer’s tracking system.

14.4.5.2 Assign technical resources to the Ticket#

14.4.5.3 Notify nature of failure to Owner within fifteen (15) minutes

14.4.5.4 For Severity 1 and Severity 2 failures, Proposer’s maintenance team shall coordinate with the Owner’s personnel who shall accompany the Proposer’s team onto any PSEN premises, and shall arrive at the subject PSERN sites within the timeline established according to the following:

14.4.5.4.1 Core Controller Locations: 1 hour from time of dispatch

14.4.5.4.2 Regional Dispatch Centers: 1 hour from time of dispatch

14.4.5.4.3 Rural King County: 2 hours from time of dispatch

14.4.5.4.4 Proposer shall remotely access PSERN within 15 minutes of dispatch to troubleshoot.

14.4.5.4.5 Allowances shall be made for added time due to air and/or sea transportation service delays or force majeure.

14.4.5.4.6 Respond, restore functionality and repair or replace failed Infrastructure Equipment based on times in the Severity Response and Restoration Table 14.5. Allowances shall be made for added time due to force majeure.
14.4.5.4.7 Maintain virus protection software, operating system patches for any equipment that may interact with the PSERN equipment.

14.4.6 Proposer shall perform the following on-site alongside the Owner’s personnel:

14.4.6.1 Run diagnostics on the Infrastructure.

14.4.6.2 Work with Owner’s personnel to replace a failed Equipment Unit or Module as determined appropriate by the Owner. The replacement Unit or Module may be taken from the Owner’s or Proposer’s inventory of spare Field Replaceable Units (FRU). If Proposer depot is providing the FRU, Proposer’s designated maintenance team is responsible for requesting the return authorization.

14.4.6.3 Provide materials, tools, documentation, physical planning manuals, diagnostic/test equipment and any other requirements necessary to perform the service.

14.4.6.4 If a Subcontractor is needed to restore the system, the Proposer’s designated maintenance team should accompany Subcontractor personnel onto the PSERN site.

14.4.6.5 Provide Units, Modules or FRUs

14.4.6.6 Maintain and store in an easily accessible location any and all Software needed to restore the System.

14.4.6.7 Maintain and store in an easily accessible location proper System backups.

14.4.6.8 Document Ticket resolution

14.5 Technical Support Service

14.5.1 Description of Service

14.5.1.1 Technical Support service provides centralized remote telephone support for technical issues that require a high level of communications systems expertise or troubleshooting on Equipment. The Proposer’s Technical Support Service Operation shall be staffed with subject matter experts who specialize in the diagnosis and resolution of system performance issues. These specialist staff shall remotely access the PSERN or replicate the problem in the system laboratory to return the PSERN to full operation as quickly and efficiently as possible. When needed, the technical support staff shall provide troubleshooting guidance over the telephone and work with the local service technician or PSERN staff to produce an efficient resolution. Technical support staff shall have access to Proposer’s factory engineers to provide the highest level of technical support available.

14.5.1.2 Proposers shall provide system technical support on a 24 hour x 7 day x 365 day per year basis. This support shall be readily available by telephone, with minimal delay. Field engineer or senior technician support shall also be available to the Owner with two (2) days prior notice to Proposer.

14.5.1.3 Due to the system size and complexity and critical nature of the PSERN, the Owner requires real time telephone access to subject
matter experts should system Equipment and Software problems be experienced at any time of the day or night.

14.5.1.4 The Proposer shall provide an initial point-of-contact and escalation points-of-contact for support and service of each element of the PSERN. This technical support shall be located in the United States and reachable by telephone on a 24 hour X 7 day X 365 day per year basis.

14.5.2 Proposer Responsibilities:

14.5.2.1 Respond to requests for technical support for the restoration of failed systems and diagnosis of operation problems

14.5.2.2 Advise caller of procedure for determining any additional requirements for issue characterization, and restoration which includes providing a known fix for issue resolution when available.

14.5.2.3 Attempt remote access to the PSERN for remote diagnostics when possible.

14.5.2.4 Maintain communication with Proposer’s maintenance team and Owner’s technicians in the field until close of the Ticket #, as needed.

14.5.2.5 Coordinate technical resolutions with Subcontractors, as needed.

14.5.2.6 Escalate and manage support issues, including PSERN issues, to Proposer’s engineering and product groups, as applicable.

14.5.2.7 Provide configuration change support to PSERN that have remote access capability.

14.5.2.8 Determine, in its sole discretion, when a Ticket # requires more than the technical support services described in this subsection, and notify Owner of an alternative course of action.

14.5.2.9 Within fifteen (15) minutes after the Proposer detects or receives a report from the Owner of a failure, problem or other incident in any element of the system, the Proposer shall notify or the Owner of the factory trained service technician assigned to respond to the call. All failures shall be initially categorized as Severity 1. The Proposer may assign a lower Severity level subject to the Owner’s agreement.

14.5.2.10 The Proposer shall respond, restore functionality, and repair or replace Equipment as necessary depending on the Severity of the failure in accordance with the Severity Response and Restoration Table.
<table>
<thead>
<tr>
<th>Severity Level</th>
<th>On-Site Response Time</th>
<th>Restoration and Replacement Tim</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severity 1</td>
<td>Technician enroute within fifteen (15) minutes after Proposer detects or is notified of the failure</td>
<td>Within four (4) hours of detection or report of failure, restore full functionality and if Equipment is malfunctioning, install FRU. If Owner’s spare Equipment is used, provide FRU to Owner within twenty-four (24) hours after removal from Owner’s inventory.</td>
<td>• Failure of any system control equipment element. • Any failure which results in the loss of wide area operation of one or more simulcast radio sub-system.</td>
</tr>
<tr>
<td>Severity 2</td>
<td>Technician enroute within fifteen (15) minutes after Proposer detects or is notified of the failure</td>
<td>Within twelve (12) hours of detection or report failure, restore full functionality and if Equipment is malfunctioning, install FRU. If Owner’s spare Equipment is used, provide FRU to Owner within twenty-four (24) hours after removal from Owner’s inventory.</td>
<td>• Loss of 20% or more voice talk-path capacity at site. • Loss of operation of any individual site that comprises a part of a simulcast subsystem or multicast site. • Any microwave failure which causes either a loss of traffic through a path or loss of node redundancy. • Central management failure • Dispatch center failure impacting operations. • Loss of connectivity of any dispatch or RF site to the core network. • Failure of central logging recording system. • Environmental alarms, such as HVAC, DC power, backup power, and obstruction warning. • This level represents major issues that results in an impaired or unusable sub-system, or loss of critical features from the Owner’s perspective.</td>
</tr>
<tr>
<td>Severity 3</td>
<td>Technician enroute as soon as possible at Proposer detection or is notified of the failure</td>
<td>Within four (4) hours of detection or report of failure, restore full functionality and if Equipment is malfunctioning, install FRU. If Owner’s spare Equipment is used, provide FRU to Owner within twenty-four (24) hours after removal from Owner’s inventory.</td>
<td>• Loss of less than 20% of voice talk-path capacity at any site. • Any microwave failure or alarm which does not result in loss of traffic or redundancy. • No more than 1 console out-of-service at any dispatch location • Loss of any NMS workstation. • This level represents moderate issues that limit Owner’s normal use of the system, sub-system product, or major non-critical features from Owner’s perspective</td>
</tr>
</tbody>
</table>

Table 14.5 Severity Response and Restoration Table

14.5.3 Notwithstanding the above provisions, the Proposer agrees that the Owner may reassign the severity of a failure by telephone or email notice and the Proposer shall respond in accordance with the Owner’s determination.

### 14.6 Infrastructure Equipment Repair Service

#### 14.6.1 Description of Service

14.6.1.1 All failed Infrastructure Equipment shall be repaired.

#### 14.6.2 Proposer Responsibilities:

14.6.2.1 Provide Return Material Authorization (RMA) number upon Owner or Proposer’s maintenance team request for Infrastructure Equipment repair.

14.6.2.2 Receive malfunctioning Infrastructure Equipment from Owner or Proposer’s maintenance team and document its arrival, repair and return.

14.6.2.3 Perform the following service on Proposer infrastructure:

14.6.2.4 Perform an operational check on the infrastructure to determine the nature of the problem.

14.6.2.5 Verify that Infrastructure Equipment is fully functional and meets the Contract’s specifications.

14.6.2.6 Perform a module level test on all serviced Infrastructure Equipment.

14.6.2.7 Perform a system level test on select Infrastructure Equipment.

#### 14.6.3 Provide the following service on select third party Infrastructure Equipment:

14.6.3.1 Perform pre-diagnostic and repair services to confirm Infrastructure Equipment malfunction and eliminate sending correctly functioning infrastructure to third party vendor for repair, when applicable.

14.6.3.2 Track Infrastructure sent for repair.
14.6.3.3 Perform a post-test after repair by Proposer to confirm malfunctioning Infrastructure Equipment has been repaired and functions properly in PSERN configuration, when applicable.

14.6.3.4 Re-program repaired infrastructure to original operating parameters based on PSERN templates.

14.7 System Updates

14.7.1 Description of Service

14.7.1.1 Proposer shall provide and install all Updates to the Software including the Updates more fully described in Section 14.8.

14.7.1.2 Updates shall be performed and installed by Proposer factory personnel experienced in Update deployments during the warranty period.

14.7.2 Proposer Responsibilities:

14.7.2.1 Provide Updates to all Proposer Software and when and if available, Third Party Software Updates, done in coordination with the Owner. By way of example and not limitation, System Updates include Operating Software (“OS”), application software, patches, service packs, and host-based intrusion detection sensor (IDS) signature files. Updates to Microsoft Windows shall occur at least monthly and Updates to Oracle, Sun Microsystems and Red Hat Unix/Linux OS and IDS signature files at least quarterly.

14.7.2.2 Proposer agrees to provide only Updates that have been analyzed, pre-tested, and certified in a dedicated test lab emulating PSERN configurations to ensure compatibility with PSERN.

14.7.2.3 As Updates becomes available, Proposer shall coordinate with Owner to schedule and install on PSERN.

14.8 Network Security Monitoring and Security Updates

14.8.1 Description of Services

14.8.1.1 Network security monitoring shall occur from the Proposer’s facility and shall actively manage security elements present on the PSERN, to mitigate risks associated with malware, or other cyber-attacks, whether deliberate or inadvertent.

14.8.1.2 Security analysts shall have direct and immediate access to Proposer engineers for rapid resolution and take additional steps to reduce vulnerabilities to potential attack and protect critical radio network infrastructure.

14.8.1.3 Security-related Update service in conjunction with security monitoring shall include automatic intrusion detection signatures and anti-virus Updates. To safeguard the PSERN from virus attacks, Proposer shall obtain anti-virus definitions from the commercial supplier, and pre-test them on a dedicated system with the standard supported configurations prior to making an Update available to the PSERN. Security monitoring service shall enable the Proposer to perform periodic, and when needed immediate, deployment of the latest release of anti-virus definitions and intrusion-detection sensor signature files on the PSERN.
network interface barrier. Proposer shall also modify intrusion sensor settings and Updates to firewall settings as necessary.

14.8.2 Monitored Elements include:

14.8.2.1 Packet Routing Network
14.8.2.2 Controllers
14.8.2.3 All Servers
14.8.2.4 Gateways
14.8.2.5 Dispatch Consoles

14.8.3 Proposer Responsibilities:

14.8.3.1 Provide dedicated connectivity through a private network connection necessary for monitoring the PSERN.
14.8.3.2 Coordinate with Owner to maintain Proposer service authentication credentials.
14.8.3.3 Perform continuous monitoring of system elements as defined in the Monitored Elements list.
14.8.3.4 Obtain anti-virus definitions for the Microsoft Windows platform, intrusion detection sensor (IDS) signatures, operating system security patches/updates, as available, from Proposer selected commercial suppliers.
14.8.3.5 Notify the Owner whenever Updates to anti-virus definitions, including third-party operating system software are available. The Contractor shall make it possible for the Owner to “pull-in” such files when the Owner deems appropriate. Contractor shall have the duty to push high priority Updates to the Owner via email or downloadable. High priority Updates are classified as Category 4 (Severe, difficult to contain) and Category 5 (very severe, very difficult to contain).
14.8.3.6 Test anti-virus definitions, intrusion detection sensor signatures for Proposer supplied IDS, operating system security patches/updates by deploying them on a dedicated test System with the standard supported configurations, which include Proposer’s then current approved cohabitated applications for current system release and three previous system releases.
14.8.3.7 Confirm that tested anti-virus definitions, intrusion detection sensor signatures for Proposer supplied IDS, and operating system security patches/updates do not degrade or compromise System functionality on dedicated test System within the standard supported configurations.
14.8.3.8 Deploy pre-tested Updates weekly to anti-virus management server and intrusion detection sensor for Proposer supplied IDS (if present on the System) upon successful completion of the weekly test cycle to be completed one week after release by commercial supplier unless an issue is detected or as determined necessary by Proposer. High-priority updates shall be made available to the Owner within 24 hours of commercial supplier release.
14.8.3.9 Release and notify Owner when operating system security patches/Updates are certified and available. Operating system security patches shall be released as available from commercial supplier and upon successful completion of test cycle or at Proposer's discretion.

14.8.3.10 Maintain annual PSERN licenses for anti-virus definitions and intrusion detection sensor signatures for IDS supplied to Owner by Proposer with selected commercial supplier.

14.8.3.11 Proposer to deploy pre-tested operating system software patches on the PSERN.

14.9 Preventive Maintenance

14.9.1 Description of Service:

14.9.1.1 Proposer shall provide Network Preventative Maintenance in accordance with approved plan. This work shall be performed during standard Business Days and as scheduled with the Owner.

14.9.2 Minimum Requirements for Proposer's Preventive Maintenance Plan:

14.9.2.1 Perform quarterly, semi-annual, and annual site maintenance visits with the intent to maintain Infrastructure Equipment according to manufacturer operational specifications.

14.9.2.2 Quarterly sites visits note system performance values and full inspection of components

14.9.2.3 Semi-annual sites visits include aspects of quarterly visits plus battery checks of condition and voltage.

14.9.2.4 Annual site visits include aspects of quarterly and semi-annual visits plus full inspection of receivers, transmitters, power amplifiers, sweeps of all feedlines, antennas, combiners, tower top amplifiers (if equipped) and multicouplers with gains and losses noted, voltage and current checks on power supplies.

14.9.2.5 Notify the Owner at least ten (10) Business Days in advance of any possible PSERN downtime needed to perform this service and coordinate site access.

14.9.2.6 Physically inspect the infrastructure equipment in the PSERN (equipment cabinets, general circuitry, fault indicators, cables, and connections).

14.9.2.7 Remove any dust, and/or foreign substances from the infrastructure.

14.9.2.8 Clean or replace filters, if applicable.

14.9.2.9 Measure, record, align, and adjust the infrastructure equipment parameters in accordance with the manufacturer’s service manuals and the Rules and Regulations of the Federal Communications Commission (FCC), where applicable.

14.10 Subscriber Depot Repair

14.10.1 Description of Service

14.10.1.1 Depot level service shall include test and repair malfunctioning radios down to the discrete component level utilizing state-of-the-art test
equipment. After repair, all Equipment shall be tested and restored to factory specifications to ensure radios are in optimal condition. Firmware shall be upgraded to current release for each radio product line provided it is compatible with PSERN, and Proposer shall program and configure radios for immediate operational use in the fleet upon return. All units shall be tracked from shipment to return through a case management system where Owners can view the repair status of the radio Unit on-line.

14.10.2 Proposer Responsibilities:

14.10.2.1 Provide RMA number upon Owner request and receive failed Unit from Owner.

14.10.2.2 Test and Restore the Equipment to factory specifications, including Factory Mutual (FM), and Mine Hazard Safety Association (MHSA). Bench-check radio prior to shipment and operation.

14.10.2.3 Reprogram Equipment to original operating parameters based on the Owner template. If the Owner template or data file is not usable, a generic template or data file utilizing the latest programming software for that radio model shall be used. All radio firmware shall be upgraded to the latest release for each radio product line provided it is compatible with PSERN.

14.10.2.4 Clean external housing of the radio. External components of unit shall only be replaced when functionality has been diminished.

14.10.2.5 Pay the outbound/inbound freight charges. Proposer shall pay the inbound freight charges if the Owner or Proposer's maintenance team uses the Proposer-designated freight delivery service.

14.10.2.6 Process inventory adjustment requests received by email or fax from the Owner, or the Proposer's local maintenance team. If the request is received by email, Proposer shall email an acknowledgement to the sender.

14.10.2.7 Perform covered services as requested by Owner on the Proposer repair request form.

14.10.2.8 If applicable, notify Owner of changes in Proposer designated inventory adjustment email address or fax number.

14.10.3 Owner Responsibilities

14.10.3.1 Remove Subscriber Equipment from vehicles.

14.10.3.2 Ship portable and mobile Subscriber Equipment to Proposer designated depot facility.

14.11 DC and AC Power Systems Maintenance

14.11.1 Description of Service

14.11.1.1 Power System maintenance shall be provided by Proposer to include testing of battery plants, rectifiers and inverters.
14.11.2 Proposer Responsibilities:
14.11.2.1 Test battery plants, rectifiers and inverters for proper operation and condition.
14.11.2.2 Notify the Owner of any possible PSERN downtime needed to perform this service.
14.11.2.3 Physically inspect the power systems
14.11.2.4 Remove any dust, and/or foreign substances from the equipment.
14.11.2.5 Measure, record, align, and adjust the equipment parameters in accordance with the manufacturer’s service manuals.

14.11.3 Owner Responsibilities:
14.11.3.1 Authorize and acknowledge any scheduled PSERN downtime.
14.11.3.2 Purchase replacement batteries as needed.

14.12 System Upgrades

14.12.1 Description of Service
14.12.1.1 System Upgrades shall include all elements of the PSERN including all Infrastructure Equipment and Software and all Subscriber Equipment and Software.

14.12.2 Proposer shall provide the following software design and technical resources necessary to prepare for each of the System Upgrades:
14.12.2.1 Review PSERN Infrastructure audit data as needed.
14.12.2.2 Identify any additional or replacement Equipment needed to implement a System Upgrade.
14.12.2.3 Complete a plan defining the System Upgrade, Equipment requirements and installation, and impact to PSERN users.
14.12.2.4 Advise Owner of probable impact to PSERN users during the actual field implementation.
14.12.2.5 Program management support required to perform the System Upgrade.
14.12.2.6 All engineering, installation and other labor required to perform the System Upgrade.
14.12.2.7 Update all As-Built documentation to reflect all updated Equipment, configurations and Software.
14.12.2.8 Provide updated information to Proposer’s system support centers that reflect the System Upgrade, Software, Equipment, and configurations.
14.12.2.9 The Proposer shall integrate, test and certify functionality and compatibility of all new versions and patches of Third Party Software then available, mitigating risk of interference to PSERN operation.

14.12.3 The System Upgrade services include provision, testing and installation of Software Upgrades and Equipment as follows:
14.12.3.1 Anti-Virus Definition Updates – all Updates available at the time of the Upgrade and not already installed under Sections 14.7 and 14.8.
14.12.3.2 Minor Release (patch release) – all Updates available at the time of Upgrade and not already installed under sections 14.7 and 14.8.

14.12.3.3 Major Release (system release) – Includes all Upgrades of Proposer Software and Third-Party Software available at the time of Upgrade.

14.12.3.4 Radio Subscriber Programming Software - Includes all Upgrades of Proposer Software and Third-Party Software available at the time of Upgrade.

14.12.3.5 Equipment Refresh – Replacement and installation of all new Equipment as required to support each System Upgrade and as more fully specified in Section 14.15.

14.12.3.6 Implementation Services – Technical support and operational resources such as field engineering, field activities manager, project management and local service shop resources to provide end-to-end design, testing, on-site installation and implementation and project management services as required to support System Upgrades.

14.12.4 Proposer has the following additional responsibilities:

14.12.4.1 Proposer shall provide patch releases that have been analyzed, tested, and certified in a dedicated APCO P25 test lab to ensure that they are compatible and do not interfere with PSERN functionality. Corresponding 3rd-Party software and operating system (OS) patches shall be released quarterly or as needed upon successful completion of the regular test cycle. Once a patch release has been validated as safe for deployment on the radio network, Proposer shall post it on a secure extranet site for download and deployment.

14.12.4.2 System Upgrades shall be pre-tested and certified in the Proposer’s test lab. System Upgrades shall improve the PSERN functionality and operation from previous releases to include feature enhancements. System releases shall include significant new feature enhancements.

14.12.4.3 The Owner shall be granted access to prior software versions as needed for the purpose of downgrading product software to a compatible release version.

14.12.5 System Upgrades shall cover all elements of PSERN including:

14.12.5.1 Base stations
14.12.5.2 Site controllers
14.12.5.3 Comparators, Routers
14.12.5.4 LAN switches
14.12.5.5 Servers
14.12.5.6 Dispatch Consoles
14.12.5.7 Network Management Terminals
14.12.5.8 Network Fault Management products
14.12.5.9 Network security devices such as firewalls and intrusion detection sensors, and associated peripheral infrastructure software.

14.12.5.10 Radio Subscriber Unit Programming Software
14.13 Equipment Upgrades

14.13.1 The Proposer shall provide and install new Units of all Equipment as necessary to implement System Upgrades, including the following examples:

14.13.1.1 Servers
14.13.1.2 PC Workstations
14.13.1.3 Routers
14.13.1.4 LAN Switches
14.13.1.5 Gateways
14.13.1.6 P25 Packet Data Gateways
14.13.1.7 Firewalls
14.13.1.8 PC Workstations and Network Management Clients
14.13.1.9 Base Stations
14.13.1.10 Site Controllers
14.13.1.11 Dispatch Console Operator Positions
14.13.1.12 Conventional Channel Gateways
14.13.1.13 Interoperability Gateways
14.13.1.14 GPS Timing and Synchronization Equipment

14.13.2 Proposer shall provide all implementation services necessary to design, test, and install Equipment Upgrades as more fully specified in Section 14.12.3.6.
15 PSERN SITE DEVELOPMENT

15.1 Site Proposals

15.1.1 Proposers are encouraged to review the existing Owner regional radio system facilities listed in Reference Documents available to proposers.

15.1.2 The Owner is providing a list of other radio sites in Reference Documents that the proposer may wish to consider for its PSERN design.

15.1.3 Said Reference documents are provided only for the convenience of the Proposer and the Owner does not represent that any of the sites on either list are available or viable for use in the PSERN. It is the sole responsibility of the Proposer to identify and investigate potential sites, whether or not on one of these lists, and to include in its proposed design only those sites that are viable for use by the PSERN.

15.2 RFP Response Requirements

15.2.1 Proposer shall identify all sites proposed for its design of PSERN and clearly articulate the need for each proposed site in narrative form, with coverage maps provided that identify the incremental benefit of each proposed site to the system design.

15.2.2 Proposer shall investigate the viability of all sites for inclusion in its PSERN design and shall only propose sites that meet the viability criteria specified herein.

15.2.3 Each proposed site that is (a) not used by the Owner for its existing radio system; and (b) is not owned by a governmental entity shall be categorized as a “New Private Site.” The Proposer shall be solely responsible for taking all actions and paying all rents, expenses and other costs necessary to acquire rights, design and develop improvements and use each New Private Site for PSERN until transfer to the Owner upon Full System Acceptance.

15.3 Site Viability

15.3.1 Proposer shall demonstrate that all proposed sites are viable for use in the PSERN. This shall include the following:

15.3.1.1 A narrative that includes confirmation of legal access to the site, including easements

15.3.1.2 The existing use of the site and any site improvements that are proposed to be used as part of the design

15.3.1.3 Ownership of the existing site improvements (if to be used as part of the design)

15.3.1.4 Ownership of the underlying land and ownership of any facilities on the site

15.3.1.5 A narrative that includes confirmation of environmental suitability, power and other characteristics of the site

15.3.2 Proposer shall identify the governing jurisdiction for each site and confirm that zoning for each proposed site is suitable for the proposed use and that legal easements or other access requirements are or can be in place as a part of the final lease agreement. If new road construction or utilities construction is required, Proposer shall fully describe all such requirements.
15.3.3 For each such New Private Site, the Proposer shall demonstrate that it shall be able to meet the requirements of Part B, Section 17 and this Part C Section 15 and shall include all costs of meeting these requirements in its proposed fixed price.

15.3.4 For all proposed sites that are not New Private Sites, the Proposer shall provide a detailed estimate of the costs that would be incurred by the Owner to acquire rights, design and develop improvements and use such other sites. Any site with an estimate of more than seven hundred thousand dollars ($700,000) for acquisition, design and development shall be considered not viable.

15.4 Lease Viability

15.4.1 Proposer shall confirm that the site owner(s) of all proposed sites are amenable to use in the PSERN and identify the rent and other terms at each proposed site.

15.4.2 For New Private Sites, Proposer shall demonstrate its ability to secure a lease for a minimum of 15 years, with an option of an added 5 years, from the present owner. Because Proposer shall assign the lease for the site at Full System Acceptance, Proposer shall also secure an irrevocable statement from the owner indicating willingness to assign the lease to Owner. Owner desires clear assurance of stable, long term access by the Proposer.

15.5 Radio Site Design Requirements

15.5.1 All sites shall be designed to modern standards as typical for telecommunications facilities. These requirements form the minimal requirements. Additionally, greater reliability is required when wireless telecommunications facilities must support mission-critical, first-responder communications. Accordingly, Proposers shall, at a minimum, following the requirements for wireless communications facilities as defined in these documents:

15.5.2 All Proposal designs shall adhere to the requirements established in the IBC2009 or latest adopted version by the State of Washington. All site design and installations shall be performed in accordance with IEEE Std. 1100-2005 IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment (IEEE ‘Emerald Book’), and applicable Vendor Site Standards.

15.5.3 All site designs shall be reviewed as part of the Owner detailed design process.

15.6 Permitting for New Private Sites

15.6.1 Proposer shall have sole responsibility for all site permitting required as a part of developing New Private sites. Permitting may include all permit processes including city, county, state or Federal approvals required, include land use, building permits, as well as FAA and FCC approvals.
15.7 **Towers – General**

15.7.1 If a tower is proposed for use, Proposer shall make a determination if the existing tower will support the antenna loads imposed by the new system requirements. Proposer shall have sole responsibility for determining the structural suitability of the facility for all new appurtenances. For facilities requiring new antenna support structures, Proposer shall note the type of structure to be constructed (rooftop frame, small monopole, large monopole, three/four leg self supporting tower or guyed tower).

15.7.2 All proposed designs, whether for new or existing sites, shall be required to meet TIA/EIA 222G Requirement for critical public safety applications, for the specific location specified by the Proposer. All new towers proposed shall be designed to twist and sway rigidity standards that allow for 6 or 11 GHz microwave operation.

15.7.3 The Owner requires that all facilities proposed shall have the ability to double the number of non-microwave antennas in order to accommodate future systems growth.

15.7.4 Tower lighting and/or painting, as may be required by the FAA, shall also be described in the Proposal. Tower lighting systems shall include the ability to deliver a variety of alarm conditions to the radio or microwave NMS for ease of remote alerting and monitoring by The Owner.

15.8 **Shelter – Prefabricated**

15.8.1 Where proposed, prefabricated shelters shall be professionally manufactured by a qualified manufacturer with a demonstrated history of providing specialized wireless communications facilities. Each structure shall be provided with two spaces, each with separate secured entry shall be provided within the shelter. One space shall be designed to house electronic systems, including the radio and microwave equipment proposed. The second space shall be sized to house the generator and generator day tank. The primary fuel supply shall be installed outside of the building. The electronics space shall be sized to allow for the addition of up to four 19” x 7” EIA racks in addition to the space required for equipment required in the Proposer’s design. The minimum specifications for the building are as follows:

15.8.1.1 Floor design loading: 300 psf except 5’-6” x 8’-6” of floor area under batteries with 600 psi design loading.

15.8.1.2 Roof design loading: 150 psf

15.8.1.3 Design loading of walls: 150 mph

15.8.1.4 Floor: 5” concrete, waffle-type construction; solid type construction as needed under batteries.

15.8.1.5 Walls: 4” solid concrete; 2 - Hour Fire-rated Construction per UBC

15.8.1.6 Roof: solid concrete, 4” at eaves and 5” at ridge

15.8.1.7 Step-Joint design

15.8.1.8 5000 psi lightweight concrete

15.8.1.9 Reinforcing steel #4 & #6 bars; 60,000 psi (Grade 60 ASTM-615)

15.8.1.10 2-hour fire rated structure
15.8.1.11 Ballistics tested for *U.L.752* Level IV (HPR - 30.06 Point Blank Range)

15.8.1.12 Exterior finish of walls: Washed aggregate and sealed

15.8.1.13 Exterior finish of roof: Troweled surface and sealed

15.8.1.14 Interior finish of walls: White Nu-Poly Interior Finish

15.8.1.15 Interior finish of floor: Covered with 1/8" x 12" x 12" commercial vinyl tile with 4" base cove

15.8.1.16 Interior finish of ceiling: White Nu-Poly Interior Finish

15.8.1.17 Interior finish of partition wall: 1 hr fire rated

15.8.1.18 Wall insulation: R-16

15.8.1.19 Ceiling insulation: R-22

15.8.1.20 One (1) 4'O"x7'O" and one (1) 3'6"x7'O", Insulated, Primed & Painted, Steel Doors

15.8.1.21 Pick Guards

15.8.1.22 Hydraulic Closers Sargent #1104

15.8.1.23 Weather-stripping

15.8.1.24 NRP Stainless Steel Hinges

15.8.1.25 "T" Tie Backs

15.8.1.26 Door Bumper

15.8.1.27 Drip Caps

15.8.1.28 Door Canopies

15.8.1.29 One (1) Integrated Load Center - 200Amp Iph 120/240V - 42space distribution, ASCO catalogue number: 300I42206F5XC11BG73240V60HZ with automatic transfer switch and surge arrestor

15.8.1.30 One (1) Transtector Type 2 TVSS-MCP 120TA-200K-OD 1101-645 (main power)

15.8.1.31 One (1) Appleton # AR20044-RS 200 Amp Generator Receptacle

15.8.1.32 One (1) 200Amp 240Volt Double Throw Safety Switch, Manual transfer Switch

15.8.1.33 One (1) 60Amp 240Volt Fused Iphase Disconnect Switch, NEMA 1 - surge arrestor

15.8.1.34 One (1) secondary load center for quad boxes with 20positions, fed from main load center

15.8.1.35 Square D # QO 140M200

15.8.1.36 Ten (10) 120V, 20Amp Duplex Receptacles - grounded

15.8.1.37 One (1) 120V, 20Amp Duplex Receptacle -mounted on gen for battery charger

15.8.1.38 Eight (8) Quad Receptacles for equipment racks; 20amp individual circuits with sealaltte drops
15.8.1.39 Two (2) Exterior GFCI Receptacles
15.8.1.40 Conduit, wiring, j-boxes, connectors, sealite as required
15.8.1.41 Ten (10) 4’ Dual-Bulb, Fluorescent Lights, 40-Watt Bulbs with Wraparound Lens
15.8.1.42 Four (4) 20Amp Light Switches
15.8.1.43 One (1) Incandescent Exterior Light Fixture with Motion Detector
15.8.1.44 One (1) Emergency Light - Dual Head with Battery Backup and Exit Sign
15.8.1.45 1/2” sleeve at exterior light for security camera
15.8.1.46 Halo Ground System - Perimeter #2 A WG Stranded Green Copper with down conductors at each corner. Halo to have a 6” break opposite the MGB
15.8.1.47 All six (6) Ground Bus Bars to be Solid Tinned: Two (2) below exterior shelter coax ports, Two (2) below interior shelter coax ports, One (1) at Telco back board, and One (1) below integrated load center
15.8.1.48 The #2A WG ground wire for each row of racks shall be suspended on an independent ground lead standoff as shown.
15.8.1.49 One (1) Harger EPK24 Ground Entrance Kits - mounted under cable entry ports
15.8.1.50 Schedule 40 PVC Sleeves 1”, installed at 45 degrees through wall for ground exits
15.8.1.51 Door bonded to its frame with welding cable, no braided cable
15.8.1.52 Two (2) 48,000 BTU Wall-Mounted HVAC Unit with 5kw Heat Strip Marvair
15.8.1.53 Controller - Marvair Comstat 3
15.8.1.54 Supply & Return Grills
15.8.1.55 Economizers
15.8.1.56 One (1) Baseboard Heater, QMark 2546 - Thermostat Controlled - in generator room
15.8.1.57 One (1) 16” Exhaust Fan; gravity operated backdraft louver, w/Outside Hood and insect screen; One (1) 16” gravity intake dampers with filters and outside hood with insect screen
15.8.1.58 Fan to be thermostatically controlled
15.8.1.59 Gutter above all equipment racks with number of circuits to be determined
15.8.1.60 66 Block mounted on Telco Board
15.8.1.61 High/Low Temperature Alarm
15.8.1.62 Generator Alarms
15.8.1.63 HVAC Fail
15.8.1.64 Entry/Intrusion Alarm

RFP#1084-13-RLJ  PART C: Scope of Work and Specifications
15.8.1.65 Two (2) Heat Detectors
15.8.1.66 One (1) Smoke Detector
15.8.1.67 Surge Suppressor Alarm
15.8.1.68 One (1) 12 Port, 4” diameter, Microflect Cable Entry Ports with caps, 4x4 configuration
15.8.1.69 Two (2) PolyPhaser Earthered Entrance Panels (PEEPS), Model 8PEEP-M
15.8.1.70 Seventy (70) L.F. of 24” wide Cable Ladder with Hardware*
15.8.1.71 Ten (10) L.F. of 6” wide Cable ladder with Hardware*
15.8.1.72 One (1) 4ft x 8ft Telco Board
15.8.1.73 Provide and Install one (1) 35KW LP Vapor Generator
15.8.1.74 On-site startup in WA
15.8.1.75 One (l) Set Generator exhaust piping, thimble, and muffler wrap
15.8.1.76 One (1) Motor Operated Exhaust Shutter with Outside Hood and Insect Screen
15.8.1.77 One (l) Motor Operated Intake Shutter with Outside Hood and Insect Screen
15.8.1.78 One (1) Baseboard Heater, QMark 2546 - Thermostat Controlled - in equipment room
15.8.1.79 Document Holder
15.8.1.80 Fire Extinguisher - 10# C02
15.8.1.81 First Aid Kit
15.8.1.82 Emergency Eyewash Station
15.8.1.83 All interior cabling shall be Listed (UL or other) for indoor use
15.8.1.84 Drawings stamped by a Washington State Structural Engineer
15.8.1.85 Building shall meet all Federal, State and Local Codes, Including Washington State L&I Gold Seal Certification

15.9 Shelter – Built On-Site
15.9.1 Shelters that are built on site shall generally meet the same requirements specified for the prefabricated shelters.

15.10 Shelter - Tenant Improvements
15.10.1 Where an existing facility is to be improved rather than a new facility constructed, all improvements shall meet the requirements herein.

15.11 Generators
15.11.1 Generators supplied shall be ONAN brand or equivalent. Generator size shall be as required to support the site power requirements, including HVAC and lighting load, with an additional 15% capacity for growth. It is assumed that generator sizing shall be in the 30KW-50KW range. Generators shall be installed in a dedicated generator room within the proposed facility.
15.11.2 Generator fuel type may be diesel, LPG or alternative fuel as required. Proposer shall provide for the transmission of generator system alarm conditions. Generator system monitoring shall allow for the transmission to the radio system NMS or microwave system NMS of overcrank, start/no-start conditions, as well as other alarms.

15.12 Automatic Transfer Switches

15.12.1 Automatic transfer switches shall be provided sized suitably to support the identified loads. Manual disconnects shall also be provided to allow for connection to the Appleton external generator connection required for all site types.

15.12.2 Proposer shall provide for the transmission of ATS alarm conditions. ATS monitoring shall allow for the transmission to the radio system NMS or microwave system NMS of ATS transfer status, as well as other alarms.

15.13 Fuel Storage Systems

15.13.1 Fuel storage systems are required based on the need to have generators present at any of the proposed facilities. Fuel type shall be as required by the AHJ or land owner. Fuel storage shall be of sufficient size as to allow for 48 hours of generator operation under full site load.

15.13.2 Fuel type may be diesel, LPG or alternative fuel as required. Proposer shall include fuel spill containment systems and shall also provide for the transmission of fuel system alarm conditions. Fuel system monitoring shall allow for the transmission to the radio system NMS or microwave system NMS of low fuel condition, as well as other alarms.

15.14 Physical Security Systems

15.14.1 Proposer shall have responsibility for providing adequate physical security for the facility. This shall include locking systems, fencing with barb wire, copper anti-theft systems, bollards to protect against vehicle damage to fences, and other system that represent present best practice for public safety communications facilities. Building lock systems shall meet these requirements:

15.14.2 Commercial grade electronic locks with strike plate and latch guard hardware

15.14.3 Locks to be pre-wired to proximity reader that can read existing Owner access cards

15.15 Grounding Systems

15.15.1 Grounding systems shall be designed per the following or equivalent:

15.15.1.1 IEEE Std. 1100-2005 IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment (IEEE ‘Emerald Book’).

15.15.1.2 Motorola Solutions (formerly Motorola) R56 Standards and Guidelines for Communications Sites

15.15.1.3 Harris (formerly M/A-COM) AE/LZT123 4618/1 R3A Site Grounding and Lightning Protection

15.16 Miscellaneous Systems

15.16.1 Tower, Building, Generator and Fuel Tank Foundations

15.16.2 Retaining Walls
15.16.3 Site Access Improvements (surfacing, culverts, other improvements as may be required)
15.16.4 Site Power Upgrades
15.16.5 Antenna Mounting Structures other than Towers
15.16.6 Grounding Systems
15.16.7 Tower Lighting Systems (if required)

15.17 Construction Services

15.17.1 Proposer shall include all required construction services for New Private Sites in the Proposal. These include:

15.17.1.1 Site Preparation
15.17.1.2 Site Access Preparation
15.17.1.3 Site Power Preparation
15.17.1.4 General Contractor Services
15.17.1.5 Construction Management
15.17.1.6 Tower Erection
15.17.1.7 Tower Painting
15.17.1.8 Prefab Building Installation
15.17.1.9 New Building Construction
15.17.1.10 Other Tenant Improvements as Required for Existing Commercial Facilities
15.17.1.11 Antenna Mounting Structure Installation
15.17.1.12 Generator, And Fuel System Installation and Commissioning
15.17.1.13 New Grounding Systems and Retrofits to Existing Grounding Systems
16 PROJECT MANAGEMENT, DOCUMENTATION AND SUPPORT

16.1 Project Management Representative

16.1.1 The Proposer shall identify who they designate as the Project Manager and provide a minimum of three references for the individual.

16.1.2 The Proposer shall identify an assigned Project Manager who shall remain the sole project management point of contact for Owner from the notification to the Proposer of Owner’s desire to enter into a purchase agreement (contract). The assigned Project Manager shall remain attached to the project from its initiation to its completion.

16.2 Project Manager Responsibilities

16.2.1 A detailed implementation plan with correlated schedule shall be maintained by the Proposer Project Manager. Each phase of project implementation is to be clearly identified with a complete description of the tasks, services, activities, roles, responsibilities, milestones and deliverables associated with each phase of the project.

16.2.2 Additional Proposer project management responsibilities include task assignment, creation and maintenance of a project schedule for the overall project, communication plan with point of contact information, change management plan and project task responsibility matrix. The Proposer project management responsibilities also include creation of and maintenance of an action register for the project team.

16.2.3 The Proposer project manager shall also prepare and maintain a risk management strategy document and report on risk mitigation efforts over life of project. Throughout all phases of the project the Proposer project manager shall develop and maintain a quality standards and procedures document.

16.2.4 The Proposer Project Manager finalizes project scope with King County and act as primary point of contact for Owner on all project activities. The Proposer project manager shall also:

16.2.4.1 Chair meetings to assign tasks, evaluate progress and address issues

16.2.4.2 Coordinate primary Proposer day-to-day activities through to project signoff, as well as coordinate supporting Proposers’ day-to-day activities

16.2.4.3 Monitor progress against the agreed-upon project milestones and report on project progress as agreed to in the Communications Plan

16.2.4.4 Manage project risk through risk identification, quantification and mitigation

16.2.4.5 Develop and submit change orders (if any) until project completion

16.2.4.6 Review delivered systems and facilities for defects and ensure the requirements for Proposer performance per the agreed-upon terms and conditions of the contract are complied with

16.2.5 Finally, the Proposer Project Manager manages project close-out activities, including sign-off on close-out activities and final deliverables.
16.3 Quality Management

16.3.1 The Owner fully expects that the Proposer shall employ and dedicate the highest quality skilled technical labor to execute the work needed. Quality work, adherence to safety standards and evidence of good engineering practices are expected to be evident in the build-up, installation and commissioning of this replacement system, and shall be validated by Owner representatives as part of the work inspection phase.

16.3.2 Proposer shall prepare and maintain a Project Quality Plan, continuously monitor the quality of all project deliverables, and issue monthly quality reports to Owner. Proposer shall clearly identify a method that shall be used to provide project Quality Assurance (QA). This should define all areas where a QA process shall be used, the method by which QA processes shall be applied and the project QA representative.

16.3.3 The project QA representative may change over each project phase but must be an individual or group unaffiliated with the actual design, product, installation or optimization of the project. The project QA representative shall provide written reports at each phase of the project that states the degree of QA compliance and any deviations from the plan or projected results agreed to during the project contract negotiation phase.

16.4 Project Staffing

16.4.1 Proposers shall provide a list of all staff positions that will be assigned to this project. The list shall include position name, expected number of hours spent in support of the Owner project per week, and the activities the position will be responsible for. The Proposer shall include resumes, no more than two (2) pages in length, which states the individual's particular skill level, education, experience, past project and any other pertinent information as it would relate to a project of this size and complexity. Proposer shall identify the capabilities and experience of the Project Manager, the LMR chief engineer, the Backhaul Engineer, the Field Activities Manager and the Quality Control Representative.

16.4.2 Proposers shall also provide a description of the proposed project team structure and internal controls to be used during the course of the project, including all subcontractors. Proposers shall provide an organizational chart of the firm indicating lines of authority for personnel involved in performance of this contract and relationships of this staff to other current projects. This chart must also show lines of authority to the next senior level of management and to subcontractors. Identify who within the firm shall have final authority for the work.

16.5 Project Initiation

16.5.1 Proposer Project Manager shall initiate the implementation process. Proposer shall conduct the project initiation meeting(s) with Owner representatives to include the following activities.

16.5.1.1 Introduction of the Proposer and Owner Project Managers as the single point of contact with authority to make routine project decisions

16.5.1.2 Introduction of all project team participants

16.5.1.3 Review of the roles of the project participants to identify communication flow and decision-making authority between participants

16.5.1.4 Review of the overall project scope and objectives
16.5.1.5 Review of the resource and scheduling requirements.
16.5.1.6 Review the draft project schedule addressing milestones and key deliverables
16.5.1.7 Review of the Project Management Plan and processes

16.5.2 This activity is considered complete when the Project Kickoff Session has been held with Proposer and Owner representatives in attendance, and when project scope, schedules, procedures, roles and responsibilities have been documented and agreed upon.

16.6 Detailed Design Development and Review

16.6.1 After the kick off meeting, Proposer shall meet with Owner’s project team to achieve written agreement on the PSERN design, identify any special system or product requirements and their impact on system design or implementation, and refine the system implementation plan and plan documentation.

16.6.2 Proposer shall provide, at a minimum, the following documents to Owner for its review and approval:

16.6.2.1 Document Index
16.6.2.2 Project Schedule
16.6.2.3 Statement of Work
16.6.2.4 System Descriptions
16.6.2.5 Final Design Documentation
16.6.2.6 Final Design of Backhaul System
16.6.2.7 Final Design of Land Mobile Radio System
16.6.2.8 FCC License Applications
16.6.2.9 System IP Plans
16.6.2.10 Site Layout Drawings
16.6.2.11 Shelter Floor Plan Drawings
16.6.2.12 Rack Elevation Drawings
16.6.2.13 System Block and Level Diagrams
16.6.2.14 Equipment Lists
16.6.2.15 Field Acceptance Test Plan (FATP)
16.6.2.16 System Optimization and Coverage Acceptance Test
16.6.2.17 User Manuals
16.6.2.18 Installed Equipment Inspections (100%)
16.6.2.19 Measure Values (100%)
16.6.2.20 Functional Testing
16.6.2.21 Backhaul System Factory Acceptance Test Plan
16.6.2.22 Backhaul System Field Test Plan
16.6.2.23 Final Transition Plan
16.6.2.24 Quality Assurance and Quality Control Plan
16.6.2.25 Training Plan
16.6.2.26 Preventative Maintenance Plan
16.6.2.27 System Administrator Documentation and System Programming parameters
16.6.2.28 System Operation and Maintenance Manuals

16.6.3 During this period, Owner shall:
16.6.3.1 Provide access to all facilities for system installation
16.6.3.2 Provide contact information for all Owner personnel associated with the PSERN.

16.6.4 This activity is complete when all documentation and detailed documents associated with this phase have been delivered to Owner, reviewed and approved by Owner, and signed by the designated representative from Owner. After acceptance, Proposer shall schedule all factory orders for shipment to meet the approved project schedule. Each of the specific design activities associated with developing these design documents is described in the following section. Some Detailed Design Development activities shall involve the review and finalization of multiple documents.

16.7 Finalize Project Schedule
16.7.1 The objective of this task is to finalize the preliminary Project Schedule contained in the Proposal. This finalization shall occur prior to issuance of Notice To Proceed.
16.7.2 The accepted Project Schedule shall become the governing Project Schedule incorporated into the contract, and is subject to change only upon mutual agreement of Proposer and Owner in accordance with Part B, Section 12.

16.8 Finalize System Design
16.8.1 Proposer has provided in the Proposal a comprehensive System Design meeting the requirements established by Owner. This design shall serve as the baseline design. During the detailed design development process, Proposer and Owner shall work together to finalize the System Design.

16.9 Finalize Statement of Work
16.9.1 Proposer shall provide a comprehensive Statement of Work meeting the requirements established by Owner. This Statement of Work shall serve as the baseline design. During the detailed design documentation development process, Proposer and Owner shall work together to finalize the Statement of Work for the Owner radio system.

16.10 Finalize Radio System Detailed Design
16.10.1 Proposer shall provide a detailed radio system design and documentation meeting the requirements established by Owner. During the detailed design documentation development process, Proposer and Owner shall work together to finalize the detailed radio system design and documentation for the PSERN.
16.10.2 Proposer shall provide a detailed coverage design as depicted in the coverage maps contained in the proposal. During the detailed design, Proposer and Owner
shall work together to finalize sites for inclusion in Owner radio system. Proposer shall analyze the coverage and evaluate frequency compatibility to aid Owner in finalizing radio sites and radio site configurations. During the detailed design development process, Proposer and Owner shall work together to finalize the radio system coverage design for the Owner radio system, based on any changes to the proposed sites by Owner.

16.11 As - Built System Documentation

16.11.1 Proposer shall supply as-built documentation for all supplied systems. Documentation shall be provided as both printed copies and as PDF documents. Documentation shall be provided in Owner maintainable native formats (MS Office, Visio, AutoCAD or other formats) or PDF’s where the provided documentation depends on Proposer-proprietary formats.

16.11.2 One (1) full copy of each site’s system as-built drawing set shall be left at each site along with a copy of all applicable equipment and system manuals as a permanent reference. Thirty (30) master system as-built documentation sets and copies of all applicable equipment and system manuals shall be provided for central retention, along with softcopies of all documents in both their native formats and as PDF’s.

16.11.3 A final, fully integrated as-built drawing set shall be provided prior to issuance of Full System Acceptance.

16.11.4 The documentation shall, at a minimum, consist of:

16.11.4.1 Standard Equipment Manuals
16.11.4.2 System drawings
16.11.4.3 Fixed Equipment Documentation
16.11.4.4 Plan and elevation views of equipment installation at each PSERN site
16.11.4.5 Equipment inter-cabling diagrams for each site
16.11.4.6 Demarcation wiring lists
16.11.4.7 Programming and level setting data sheets
16.11.4.8 Equipment by site
16.11.4.9 Key access procedures
16.11.4.10 Site inventory lists
16.11.4.11 Remote sign-on procedures and passwords
16.11.4.12 Software versions and equipment wiring by equipment site
16.11.4.13 Field ATP test sheets and results
16.11.4.14 Maintenance Records
16.11.4.15 Warranty information
16.11.4.16 Final Design of Backhaul System
16.11.4.17 Final Design of Land Mobile Radio System
16.11.4.18 Final Transition Plan
16.11.4.19 Quality Assurance and Quality Control Plan
16.11.4.20 Backhaul System Factory Acceptance Test Plan
16.11.4.21 Backhaul System Field Test Plan
16.11.4.22 Final Implementation Plan
16.11.4.23 LMR System Factory Acceptance Test Plan
16.11.4.24 LMR System Field Installation, Inspection and Test Plan
16.11.4.25 System Optimization Plan
16.11.4.26 RF Coverage Acceptance Test Plan
16.11.4.27 Subscriber Test Plan
16.11.4.28 Mobile Radio Installation Plan
16.11.4.29 Pilot Test Plan
16.11.4.30 Functional and Operational System Test Plan
16.11.4.31 System Voice Group Mapping
16.11.4.32 Radio System Availability Test Plan
16.11.4.33 ISSI Installation and Test Plan
16.11.4.34 Tunnel Systems Integration Test Plan
16.11.4.35 CAD Message Switch Test Plan
16.11.4.36 Full System Acceptance Test Plan
16.11.4.37 Preventive Maintenance Plan
16.11.4.38 Maintenance Training Plan
16.11.4.39 User Training Plan and Sample of Training Materials
16.11.4.40 Any other required Design Deliverables specified in Part C

16.12 Equipment Manuals
16.12.1 Proposer shall provide equipment manuals covering both standard and optional features. Manuals shall be provided in sufficient quantities to meet County requirements. Manuals shall provide as PDF documents, and where available, in printed copies.

16.12.2 The following defines, in detail, the expected project phases for the planning, design, manufacture, installation, optimization and testing of the PSERN.

16.13 Escalation Procedures For Equipment Servicing
16.13.1 The Proposer shall provide a comprehensive outline of their escalation procedure that the Owner would be required to follow during a support request.

16.13.2 The escalation procedure should ensure that Owner receives 100% accountability from the Proposer for all service requests, the assignment of the personnel with the technical skill levels commensurate with the nature of the problem, and one that ultimately ensures the highest degree of direct support to Owner.

16.13.3 The Proposer shall specifically outline sequence of events in the trouble ticket and support process, and the problem investigation, validation and resolution process.

16.13.4 The Proposer shall outline local versus regional or national support escalation, telephonic access numbers, and guaranteed response time(s) during after-hours and weekends.
17 REGULATIONS, SPECIFICATIONS AND CODES

17.1 Background

17.1.1 Equipment and implementation services provided by Proposer shall meet or exceed all applicable standards put forth by the following publications and standards. These documents shall be the current issue as of the date of the Proposal.

17.1.2 The referenced codes establish a minimum level of requirements. In situations where provisions of the various codes conflict with each other, the more stringent provision shall govern.

17.2 FAA Rules

17.2.1 Obstruction Marker and Lighting Advisory Circular AC 70/7460-1K, referenced under Federal Regulations 14 CFR Part 77 Notice of Proposed Construction or Alteration.

17.3 FCC Rules

17.3.1 FCC Rules and Regulations, Rule Parts as applicable, most recent edition as of the date of the Contract;

17.3.1.1 FCC Rules, Part 2
17.3.1.2 FCC Rules, Part 15
17.3.1.3 FCC Rules, Part 22
17.3.1.4 FCC Rules, Part 80
17.3.1.5 FCC Rules, Part 90
17.3.1.6 FCC Rules, Part 101

17.4 Telecommunications and Electronic Standards

17.4.1 American National Standards Institute (ANSI) and EIA/TIA Telephone Industries Association (TIA)/Electronic Industries Association (EIA) standards, most recent edition as of the date of the Contract;

17.4.2 TIA/EIA-222 (latest version most recent edition as adopted and amended by the AHJ as of the date of this RFP) – Structural Standards for Steel Antenna Towers and Antenna Supporting Structures

17.4.3 TSB-10-F – Interference Criteria for Microwave Systems

17.4.4 TSB88, All system performance and design criteria are to be defined, calculated and expressed consistent with the latest released version of TSB-88, TIA/EIA Telecommunications System Bulletin, Wireless Communications Systems-Performance in Noise and Interference-Limited Situations- Recommended Methods for Technology-Independent Modeling, Simulation, and Verification

17.4.5 EIA-310 (latest version) – Racks, Panels, and Associated Equipment

17.4.6 TIA-603 Rev. C - Land Mobile FM or PM - Communications Equipment - Measurement and Performance Standards

17.4.7 TIA/EIA-195 Rev. C - Electrical and Mechanical Characteristics for Terrestrial Microwave Relay System Antennas and Passive Reflector;
17.4.8 EIA-210 Rev. 58 - Terminating and Signaling Equipment for Microwave Communications Systems;
17.4.9 EIA-252 - Standard Microwave Transmission System;
17.4.10 EIA/ECA-310 Rev. E - Cabinets, Racks, Panels and Associated Equipment;
17.4.11 TIA-329.1 Rev. C - Minimum Standards for Communications Antennas, Base Station Antennas
17.4.12 TIA-329.2 Rev. C - Minimum Standards for Communication Antennas, Vehicular Antennas
17.4.13 T1.105 – Digital Hierarchy Optical Interface Rates and Formats Specifications
17.4.14 T1.106 - Digital Hierarchy Optical Interface Specifications (single mode)
17.4.15 T1.102 – North American Digital Hierarchy – Electrical Interfaces
17.4.16 T1.313 – Electrical Protection for Telecommunications Central Offices and Similar Type Facilities
17.4.17 T1.333 – Grounding and Bonding of Telecommunications Equipment
17.4.18 T1.334 – Electrical Protection of Communications Towers and Associated Structures
17.4.20 T1.403 – Extended Superframe Format Interface Specification
17.4.21 ANSI-J-STD-607-A-2002 _ Commercial Building Grounding and Bonding Requirements For Telecommunications

17.5 Project 25 Standards

17.5.1 Project 25 Common Air Interface, Trunked Operation, OTAR and Data Operation, as specified by the following documents:

17.5.2 TIA-102.CCAB (October 2011) Project 25, Two Slot TDMA, Transceiver Performance Recommendations
17.5.3 TIA-102.BCAD (September 2011) Project 25 Trunked Radio System Two Slot TDMA Voice Services Common Air Interface Conformance Specification
17.5.4 TIA-102.CACC-1 (August 2011) Project 25 Inter-RF Subsystem Interface Conformance Test Procedures
17.5.5 TIA-102.CCAA (August 2011) Two-Slot TDMA, Transceiver Measurement Methods
17.5.6 TIA-102.AABB-B (July 2011) Project 25 - Trunking Control Channel Formats - Digital Radio Technical Standards
17.5.7 TIA-102.CABC-B-1 (July 2011) Project 25 Interoperability Testing for Voice Operation in Trunked Systems
17.5.8 TIA-102.BACD-B (July 2011) Project 25 - Inter-RF Subsystem Interface (ISSI) - Messages and Procedures for Supplementary Data
17.5.9 TIA-102.BACA-A-3 (July 2011) Project 25 Inter-RF Subsystem Interface Messages and Procedures for Voice and Roaming Management Services - RFSS
17.5.33 TIA-102.CACD (October 2009) Project 25 - Inter-RF Subsystem Interface - Interoperability Test Procedures for Trunked Systems Involving the ISSI
17.5.36 TIA-102.BABA-1 (July 2009) Project 25 Half-Rate VOCODER Annex
17.5.37 TIA-102.BBAB (July 2009) Project 25 TDMA, Phase 2 Two-Slot TDMA Physical Layer Description" (if approved, to be published as TIA-102.BBAB)
17.5.38 TIA-102.AABG (April 2009) Project 25 Conventional Control Messages
17.5.39 TIA-102.CAEA (April 2009) Project 25 Conformance Profile - Level One - Basic Conventional Operation
17.5.40 TIA-102.BAJB (February 2009) Project 25 Tier 1 Location Services
17.5.41 TIA-102.AABC-B-5 (January 2009) Trunking Control Channel Messages - Radio Unit Monitor Enhancement
17.5.42 ANSI/TIA-102.AABC-B-5 (December 2008) Project 25 Trunking Control Channel Messages- Radio Unit Monitor Enhancements
17.5.43 TIA-102.AABD-A (December 2008) Trunking Procedures
17.5.44 TIA-102.CAAA-C (December 2008) Digital C4FM/CQPSK Transceiver Measurement Methods
17.5.45 TIA-102.CACA-1 (December 2008) P25 Inter-RF Subsystem Interface Measurement Methods for Voice Services-- Addendum 1 - Trunked Console ISSI
17.5.46 TIA-102.CACB-1 (December 2008) P25 Inter-RF Subsystem Interface (ISSI) Performance Recommendations for Voice Services - Addendum 1 - Trunked Console ISSI
17.5.47 ANSI/TIA-102.AABC-B-4 (September 2008) Project 25 Trunking Control Channel Messages: FDMA/2-Slot TDMA Control Channel
17.5.48 TIA-102.AABC-B-4 (September 2008) Trunking Control Channel Messages Addendum – TDMA Traffic Channel Operations
17.5.49 TIA-102.BACE (June 2008) P25 Conventional ISSI Messages and Procedures
17.5.50 TIA-102.BAAD-1 (March 2008) Common Air Interface Operational Description for Conventional Channels Addendum 1
17.5.52 TIA-102.AABC-B-3 (February 2008) Trunking Control Channel Messages Addendum – Supplementary Data ISSI
17.5.53 TIA-102.CACA (April 2007) P25 Inter-RF Subsystem Interface (ISSI) Measurement Methods for Voice Services
17.5.54 TIA-102.CACB (April 2007) P25 Inter-RF Subsystem Interface (ISSI) Performance Recommendations for Voice Services
17.5.55 TIA-102.CADA (April 2007) P25 Fixed Station Interface Conformance Test Procedure

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17.5.56 TIA-1020 (January 2007) IP Based Location Services
17.5.57 TIA-1102 (December 2006) Minimum Performance Specification for Terrestrial Mobile Multimedia Multicast Forward Link Only Devices
17.5.59 TIA-102.BAHA (June 2006) Project 25 Fixed Station Interface Messages and Procedures
17.5.60 TIA-102.BADA-1 (April 2006) P25 Telephone Interconnect Requirements and Definitions (Voice Service) Addendum 1 - Conventional Individual Calls
17.5.61 TIA-102.BAAB-B (March 2005) Project 25 - Common Air Interface - Conformance Test
17.5.63 TIA-102.AACD (February 2005) Project 25 - Digital Land Mobile Radio, Key Fill Device (KFD) Interface Protocol
17.5.64 TIA-102.AAAB-A (January 2005) Project 25 - Digital Land Mobile Radio - Security Services Overview
17.5.69 TIA-102.BABB (December 2003) Project 25 - VOCODER Mean Option Score Conformance Test
17.5.70 TIA-102.BABA (December 2003) Project 25 - VOCODER Description
17.5.71 TIA-102.BAAA-A (September 2003) Project 25 - FDMA - Common Air Interface
17.5.76 TIA/EIA-102.AACB (November 2002) Digital Private Land Mobile Radio - Over-the-Air (OTAR) Operational Description


17.5.82 TIA/EIA-102.AAAD (July 2002) Project 25 - Block Encryption Protocol

17.5.83 TIA-102.AAAA-A (February 2001) Project 25 DES Encryption Protocol

17.5.84 TIA/EIA-102.AAAC (February 2001) Conformance test for the Project 25 DES Encryption Protocol

17.5.85 TIA-102.BAAA-1 (August 1999) APCO Project 25 - FDMA Common Air Interface - Addendum 1 (Superseded by TIA-102.BAAA-A)


17.5.88 TIA/EIA/IS-102.BABC (June 1996) Project 25 - VOCODER Reference Test (superseded by TIA/EIA/IS-102.BABC)


17.5.90 TIA-102.BAAA (May 1988) Project 25 FDMA Common Air Interface

17.6 Ruggedness Standards

17.6.1 MIL SPEC 810 C & D - Environmental Specifications, for those products proposed that include MIL 810 rating;

17.7 Quality Standards

17.7.1 All designs shall adhere to the requirements established in the IEEE Std. 1100-2005 IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment (IEEE 'Emerald Book').

17.7.2 All designs shall also adhere to Motorola R56 Standards and Guidelines for Communications Sites and M/A-COM AE/LZT123 4618/1 R3A Site Grounding and Lightning Protection or equivalent.
17.8 National, State and Local Construction Codes

17.8.1 The following code and standards are hereby referenced. Contractor shall perform all work and provide materials and equipment in accordance with the latest referenced codes and standards of the following organizations:

17.8.1.1 American National Standards Institute (ANSI)
17.8.1.2 National Electrical Manufacturer's Association (NEMA)
17.8.1.3 National Fire Protection Association (NFPA)
17.8.1.4 Underwriters Laboratories (UL) or other Listing Organization

17.9 Electrical System Design and Installation

17.9.1 National Fire Protection Association (NFPA) # 70, #1221, #250 and #800, most recent edition as adopted and amended by the AHJ as of the date of the Contract;
17.9.2 International Building Code (IBC), most recent edition as adopted and amended by the AHJ as of the date of the Contract;
17.9.3 National Electrical Code (NEC) 708, most recent edition as adopted and amended by the AHJ as of the date of the Contract;

17.10 Interference Management Standards

17.10.1 Western Washington Regional Interference Committee (formerly WWCIC) Engineering Standard #6 REV. C (02-97) For Radio Transmitting and Receiving Devices and FM Broadcast

17.11 Bellcore Technical References and Advisories and Compatibility Bulletins:

17.11.1 GR-1089-CORE – Electromagnetic Compatibility and Electrical Safety General Criteria for Network Telecommunications Equipment
17.11.2 TR-NWT-000063 – NEBS Generic Equipment Requirements Replaced by GR-63-CORE
17.11.3 GR-NWT-000253, Issue 6 – Synchronous Optical Network (SONET) Transport Systems: Common Generic Criteria, Replaced by GR-253-CORE
17.11.4 R-TSY-000496, Issue 3 – SONET Add-Drop Multiplex Equipment (SONET ADM): Generic Criteria
17.11.5 GR-1400-CORE, Issue 1 – SONET Dual-Fed Unidirectional Path Switched Ring (UPSR) Equipment Generic Criteria
17.11.6 TR-TSY-000332 – Reliability Prediction Procedures for Electronic Equipment
17.11.7 TR-TSY-000499 – Transport Systems Generic Requirements (TSGR) Common Requirements, Issue 2. Replaced by GR-499-CORE.
17.11.8 TA-TSY-000752 – Microwave Digital Systems Criteria
17.11.9 TR-TSY-000009 – Asynchronous Digital Multiplexer Requirements and Objectives Replaced by GR-499-CORE.

17.11.10 Note: The referenced codes establish a minimum level of requirements. In situations where provisions of the various codes conflict with each other, the more stringent provision shall govern.