Request for Best and Final Offer
The King and Queen / Essex County Regional Communications System

March 3, 2015

Prepared By:

King and Queen County
242 Allens Circle
King and Queen Courthouse, Va
23085
804-785-5975

Table of Contents

1. Project Overview
- 1.1. Introduction
- 1.2. Overview of this Document
- 1.3. Project Summary
- 1.4. Response Desired
- 1.5. Standards and Guidelines
- 1.6. Frequency Coordination and Licensing
- 1.7. Federal Aviation Administration (if applicable)
- 1.8. Project Management
- 1.9. QA/QC Program
- 1.10. BAFO Response Format
- 1.11. Evaluation
- 1.12. Award of Contract
- 1.13. Detailed Design (60 calendar days after contract award)
- 1.14. Detailed Design Review (60 calendar days after contract award)
- 1.15. System Shipping and Delivery

2. Radio Communications System Requirements
- 2.1. Overview
- 2.2. Project 25, Phase 2
- 2.3. Redundancy and Survivability
- 2.4. Expansion
- 2.5. Site Selection
- 2.6. Coverage
  - 2.6.1. Coverage Model and Maps
  - 2.6.2. Link Budgets

3. Radio Communications System Desired
- 3.1. Overview
- 3.2. System Control Equipment
- 3.3. Simulcast Equipment
- 3.4. Receiver Voting
- 3.5. Base Station Equipment
- 3.6. Antenna Systems
- 3.7. Gateway Devices
- 3.8. Site DC Power
- 3.9. Dispatch Console Subsystem
  - 3.9.1. General Requirements and Features
  - 3.9.2. Trunked Requirements
  - 3.9.3. Conventional Requirements
  - 3.9.4. Operator Position Equipment
  - 3.9.5. Console Networking Equipment
  - 3.9.6. Console Backup System
- 3.10. Voice Logging Recorder

3.11. Network Management Subsystem (NMS)
3.11.1. Network Management Terminals (NMT)
3.11.2. Remote Terminal Units (RTU)

4. Backhaul Network
4.1. Digital Microwave Network
4.2. Microwave Backhaul Network Engineering
4.3. Microwave Antenna System
4.4. Microwave Backhaul Network Management

5. **Subscriber Equipment**
5.1. Overview
5.2. General Requirements
5.3. Portable Radios
5.4. Mobile Radios
5.5. Control Stations

6. Facilities and Infrastructure Development
6.1. General
6.2. Towers
6.3. Shelters
6.4. Generator and Automatic Transfer Switches (ATS)
6.4.1. Propane Generator
6.4.2. Automatic Transfer Switch (ATS)
6.4.3. Propane Fuel System
6.5. Site Preparation
6.6. Fencing

7. Training
7.1. General Requirements
7.2. Operator Training
7.3. Technical/System Management Training

8. System Implementation, Test, and Acceptance
8.1. General
8.2. Staging
8.3. System Installation
8.4. Fleetmapping
8.5. Cutover Plan
8.6. Cutover
8.7. Final Acceptance Testing
8.8. Coverage Testing
8.9. 30 Day Burn In
8.10. As-Built Document
8.11. System Acceptance
8.12. Final System Acceptance

9. Warranty, Maintenance, and Support
9.1. Warranty
9.2. Maintenance
9.2.1. General Requirements
9.2.2. Maintenance Standards
9.3. Parts Availability
9.4. Spare Equipment
9.5. Post Warranty Maintenance

10. County Terms and Conditions

11. Glossary of Terms and Acronyms

Appendix A- Compliance Matrix
Appendix B- BAFO Pricing Forms
Appendix C- Fire Paging
Appendix D- UHF Analog Interoperability (UCALL40/UTAC)
Appendix E- VHF Interoperability (EMS Statewide)
Appendix F- VHF Low Interoperability (SIRS)
Appendix G- Neighboring Gateway /Control Stations Identified

1. Project Overview

1.1 Introduction

King and Queen County and Essex County intend to purchase and implement an integrated public safety wireless communication system that will provide public-safety first responders real time operable and interoperable voice and data services that support day-to-day, mutual aid, and task force operations. The system shall be highly reliable, fault tolerant, spectrally efficient, easily scalable, and meet the operational requirements for public-safety first responders and public service agencies.

The current King and Queen system is a Tait P25 Phase 1 conventional system operating on 450-470 MHz. The system in its current configuration does not support the coverage requirements of the regional initiative and requires expansion to meet those requirements. Additionally, the expansion includes such components such as consoles, microwave and logging recorders as defined in this document and within (VENDOR) supplied coverage maps and budgetary pricing to expand the current King and Queen system to meet the needs of a regional King and Queen / Essex County venture.

The purpose of this document is to define the technical and functional requirements for the King and Queen / Essex County system expansion to enable (VENDOR) Corporation to present a Best and Final Offer (BAFO), including updated pricing, for the system procurement and implementation that will fulfill those requirements.

1.2 Overview of this Document

A. The following list provides a map to this Request for a BAFO.

1. Section 2, Radio Communications System Requirements - Provides requirements for the desired communications system. King and Queen / Essex County seeks final design and pricing for the expansion of the KQ 450 MHz Project 25 Phase 1 Conventional system to a Project 25 Phase 2 Trunking Simulcast System
2. Section 3, Radio Communications System Desired – Provides functional and configuration features of the system King and Queen / Essex County desires.
3. Section 4, Backhaul Network – Provides requirements for backhaul connectivity, digital microwave backhaul equipment, and network management.
4. Section 5, Subscriber Equipment – Provides requirements for portable radios, mobile radios, and control stations.
5. Section 6, Facilities and Infrastructure Development – Provides requirements for tower construction, site preparation, fencing, equipment shelters, generators, and UPS equipment. Existing facilities shall be used to the greatest extent practical. Where not practical, this section provides requirements for tower construction, site preparation, fencing, equipment shelters, generators, and UPS equipment.
6. Section 7, Training – Provides requirements for training programs to be developed by (VENDOR).

7. Section 8, System Implementation, Test, and Acceptance – Provides requirements for system cutover, staging, installation, fleetmapping, coverage testing, and final acceptance.

8. Section 9, Warranty, Maintenance, and Support – Provides requirements for the warranty, extended warranty, maintenance, and support of the proposed system and subsystems.

9. Section 10, King and Queen / Essex County Terms and Conditions

10. Appendix A, Contains a Compliance Matrix. (VENDOR) must complete this matrix, indicating that (VENDOR) understands and complies with the contents of each section of this document. (VENDOR) must clarify any items of noncompliance in the space provided in the Compliance Matrix.

11. Appendix B, Contains BAFO Pricing Forms. (VENDOR) must complete the BAFO pricing forms to the extent possible and in accordance with instructions in this document.

12. Appendix C-G, Contains Fire paging and interoperability requirements

1.3 Project Summary

A. (VENDOR) shall be responsible for providing the following project components:

1. Furnishing and installing system equipment and ancillary facilities
2. Preparing and submitting regional coordination forms and FCC Licensing forms
3. Engineering and system design
4. Project management
5. Software installation and programming
6. Training
7. Acceptance testing, including coverage testing
8. Cutover plan and execution
9. Warranty and Maintenance

B. (VENDOR) shall be responsible for furnishing complete and fully functional systems:

1. Radio communications system, including the guarantee of radio coverage and Grade of Service (GoS)

2. Point-to-point digital microwave backhaul network

3. Radio dispatch consoles

4. Logging Recorder

5. Infrastructure facilities (e.g., towers, shelters, fencing)

6. Network management system

7. Subscriber equipment

C. (VENDOR) shall plan, coordinate and conduct work with minimal interruption of service to existing critical systems.

D. (VENDOR) shall completely describe the equipment and methods that will be used to implement the system.

E. If the system provided fails to operate as proposed due to errors or omission by (VENDOR), (VENDOR) will correct the issues at no additional cost to King and Queen / Essex County.

F. While the parties understand that this project is an expansion of an existing system, all newly supplied equipment shall be provided in new condition and be covered by a full manufacturer's warranty and maintenance service for not less than three years.

G. In the event that requirements are stated in more than one section and appear to conflict, the more stringent requirement shall apply.

1.4 Response Desired

A. King and Queen / Essex County desires a Best and Final Offer for a complete turnkey solution addressing all project requirements for systems, subsystems, and components for the primary voice communications network. The intent for this network is the provision of public-safety grade communications capabilities across the county allowing County agencies to safely, effectively, and efficiently carry out their duties.

1.4.1 Standards and Guidelines

A. (VENDOR) shall comply with the following applicable standards, rules, regulations, and industry guidelines, provided here in no particular order with no implication of priority, as they apply to (VENDOR)'s proposed solution:

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

B. (VENDOR) shall comply with industry best practices for system installation, grounding, bonding, and transient voltage surge suppression (TVSS), as outlined in the following standards:

1. Motorola Site Grounding and Lightning Protection Guidelines (AE/LZT – 123 4618/1 – latest revision)

2. Other contractor / industry standards, which (VENDOR) shall provide to King and Queen / Essex County for review and approval prior to contract award.

C. Governing codes and conflicts: If the system requirements stated herein conflict with those of the governing codes and regulations, then the more stringent of the two shall apply.

D. If (VENDOR) cannot meet any of the standards or guidelines listed above, (VENDOR) shall list and explain all deviations in their BAFO.

1.4.2 Frequency Coordination and Licensing

A. Land Mobile Radio (LMR) licenses -- (VENDOR) shall be responsible for all frequency research, prior coordination and preparation of all associated FCC license applications and submittals on behalf of King and Queen / Essex County. King and Queen / Essex County shall be responsible for coordination fees and licensing fees, if any, and signatures, as applicable. Following approval of the preliminary design phase, (VENDOR) shall provide all modifications and applicable forms to King and Queen / Essex County for review and approval. (VENDOR) shall also be responsible for any additional frequency research, support, and preparation if necessary. King and Queen / Essex County shall sign and submit all forms following approval.

B. Microwave Licenses -- (VENDOR) shall be responsible for all microwave frequency research, prior coordination and preparation of all associated FCC license applications and submittals on behalf of King and Queen / Essex County. King and Queen / Essex County shall be responsible for coordination fees and licensing fees, if any, and signatures, as applicable.

1.4.3 Federal Aviation Administration (if applicable)

A. (VENDOR) shall complete and submit any required forms to the Federal Aviation Administration (FAA).

1.4.4 Project Management

A. (VENDOR) shall provide a Project Management Plan, which includes, a detailed Work Breakdown Structure (WBS), project scope, deliverables, schedule, coordination, QA/QC processes, and risk management sections.

B. The plan shall describe how (VENDOR) intends to monitor and control the installation and deployment of the proposed system and mitigate risks in order to ensure that the system meets the design specifications and delivery/implementation schedule.

C. (VENDOR) shall establish regularly scheduled status meetings with the King and Queen / Essex County Project Team. Refer to Section 1.4.4.3 for detailed meeting requirements.

1.4.4.1 Project Scheduling

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

B. The schedule shall represent tasks associated with completing work on all items identified in the WBS. The project schedule shall be updated with actual dates as tasks are completed.

C. The updated schedule shall be provided as an agenda item for all weekly or biweekly status meetings (at the discretion of King and Queen / Essex County) between King and Queen / Essex County and (VENDOR).

D. The schedule shall address the following at a minimum:

1. Site surveys
2. Detailed design review and King and Queen / Essex County approval
3. Site preparation
4. Equipment manufacturing
5. Factory acceptance test
6. Equipment delivery
7. System installation
8. System configuration
9. System optimization
10. Acceptance testing
11. Coverage testing
12. User training
13. Fleetmap development
14. System cutover
15. System documentation development and delivery
16. System and equipment warranty

1.4.4.2 Project punch list

A. (VENDOR) shall establish and maintain a punch list, as mutually agreed to with King and Queen/ Essex County, for site facilities, equipment, and for acceptance tests.

B. The punch list shall be maintained in real time and published weekly. The punch list shall include the following at a minimum:

1. Sequential punch list item number
2. Date identified
3. Item description
4. The party responsible for resolution
5. Expected resolution date
6. Resolution date
7. The party resolving the issue
8. Details about how each punch list item was resolved and tested
9. Project manager signoff ((VENDOR)/King and Queen / Essex County)
10. Any notes about the item.

C. If responsibility for resolving an item is transferred to another person or group, a new entry shall be added to the punch list and the original entry shall be appropriately noted.

D. (VENDOR) shall be responsible for reviewing each punch list item, and advising King and Queen / Essex County of any changes. Each weekly or biweekly status meeting shall include updating the status of punch list items.

1.4.4.3 Project meetings

A. A project kickoff meeting shall be scheduled prior to the beginning of the project.

B. Weekly or biweekly project status meetings shall be scheduled following contract award and the initial kickoff meeting.

C. (VENDOR) shall provide a schedule for these meetings subject to the approval of King and Queen / Essex County.

D. (VENDOR) shall provide King and Queen / Essex County with an agenda for each meeting five days prior to the meeting and keep a detailed record of meeting discussions and action item lists.

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

1. Schedule review
2. Status of deliverables
3. Risk items
4. Changes
5. Plans for the next period
6. Action item assignments

7. Punch list review

1.4.4.4 Project staffing

A. (VENDOR) project staffing shall be managed by (VENDOR) based on workload and the level of effort throughout the implementation / installation process; however, the positions identified below shall be staffed throughout the duration of the project and shall not change without prior approval of King and Queen / Essex County.

B. (VENDOR)'s Project Manager:

1. (VENDOR) Project Manager shall be the primary point of contact between King and Queen / Essex County Project/System Manager and (VENDOR).

2. (VENDOR)' Project Manager shall bear full responsibility for supervising and coordinating the installation and deployment of the communications system; be responsible for development and acceptance of the Project Management Plan; managing the execution of the project against that plan; and overseeing the day-to-day project activities, deliverables, and milestone completion.

3. (VENDOR)'s Project Manager shall be responsible for coordination of the status meetings.

C. (VENDOR)'s Project Engineer:

1. (VENDOR)'s Project Engineer shall have the primary responsibility for developing and managing the system design and ensuring that the system is installed in accordance with the approved system design.

2. Any deviation from the system design shall be subject to project change control procedures and will not be undertaken until approved by King and Queen / Essex County.

3. (VENDOR)'s Project Engineer shall develop block diagrams, system level diagrams, and rack diagrams to assist the installation team in completing the system installation.

4. The Project Engineer shall also supervise the development and execution of the Acceptance Test Plan, the Coverage Acceptance Test Plan, and guide the project team through the processes and procedures necessary to prove that the system performs as specified in the contract. No test plan will be executed until approved by King and Queen / Essex County.

1.4.5 QA/QC Program

A. (VENDOR) shall include a Quality Assurance / Quality Control (QA/QC) plan for the King and Queen / Essex County radio communications system project. The plan shall address all stages of the project, including, but not limited to:

1. Procurement

2. System design

3. Installation
4. Implementation
5. Testing
6. Cutover

B. The QA/QC plan shall specifically describe the plans and procedures that ensure the proposed system design complies with the standards and requirements described in this BAFO.

C. The QA/QC plan shall be included as part of the Project Management Plan developed by (VENDOR) Project Manager.

D. The QA/QC plan shall be an integral part of the project and include County personnel as part of the review and approval process for all deliverables and submittals.

E. The proposed QA/QC plan shall address the following project tasks at a minimum:

1. Design analysis and verification
2. RF coverage analysis and verification
3. Design changes and document control
4. Material shipping, receiving, and storage
5. Site preparation
6. Field installation and inspection
7. Equipment inventory and tracking
8. System testing and validation
9. Software regression testing
10. Deficiency reporting and correction
11. Implementation and cutover
12. Training and certification

1.5 BAFO Response Format

A. (VENDOR) shall complete all mandatory submittals provided in Appendix A – Mandatory Submittals.

B. (VENDOR) shall adhere to the BAFO format provided below, organized by Section:

1. Section 1: Cover letter
2. Section 2: Table of contents
3. Section 3: Executive summary
4. Section 4: Qualifications

(VENDOR) shall provide information describing experience and qualifications with similar projects in their BAFO, or upon request from King and Queen / Essex County, including, but not limited to the following:

a. Descriptions of (VENDOR) qualifications

b. Resumes of key personnel

c. Supplementary information

5. Section 5: Description of the system, including equipment, software, design, and services to be provided:

   a. Radio communications system

   b. Radio dispatch consoles

   c. Voice logging recorder

   d. Network management subsystem

   e. Microwave backhaul connectivity including preliminary path profiles

   f. Radio and microwave channel plans

   g. Subscriber equipment

   h. Site infrastructure

   i. Tower profile drawings including antenna mounting locations and ancillary equipment

   j. Equipment room drawings

   k. Equipment rack elevation drawings

   l. Additional subsystems

   m. RF coverage predictions

   n. Detailed equipment specification sheets for all proposed equipment

   o. Scope of Work documentation detailing complete system installation on a site by site basis

   p. System design information shall include a complete detailed description, block diagrams, equipment layouts, and equipment lists necessary to provide a complete and comprehensive description.

6. Section 6: Project Management plan including preliminary project schedule with detailed Gantt chart

7. Section 7: Quality Assurance / Quality Control (QA/QC) plan

8. Section 8: Training programs.

9. Section 10: System, subsystem and subscriber warranty information

10. Section 11: System testing documentation including staging factory acceptance testing, coverage acceptance testing, 30-day operational test and final acceptance testing.

11. Section 12: Any documentation or material not covered in any other sections.

12. Section 13: Post-Warranty Maintenance

13. Section 14: Total BAFO cost and detailed pricing breakdown

    (VENDOR) shall provide total BAFO cost and itemized pricing by using the pricing forms provided in Appendix B – BAFO Pricing Forms, to the greatest extent possible. Costs for OPTIONAL items shall also be provided on the forms.

1.6 Evaluation

A. The submission will be reviewed to determine if the best and final offer requirements indicated herein have been met and represent the best value for the jurisdictions involved. The accepted response will be reviewed by the policy team and scored against stated criteria as well as references. The committee will evaluate all proposals in accordance with criteria set forth in this RFP and applicable law.

   During the evaluation process the policy team may seek information for to clarify (VENDOR)'s proposal. (VENDOR) must submit written clarifications and such clarifications shall become part of the proposal

   1. King and Queen / Essex County will utilize the BAFO pricing forms and compliance matrix as reference of compliance in response to this BAFO request.

   2. King and Queen / Essex County reserves the right to accept all or part of the (VENDOR) response depending solely upon the requirements and needs of King and Queen / Essex County.

   3. King and Queen/Essex County may seek clarification and make decisions on acceptance based on criteria as established by this best and final offer criteria and/or upon the recommendation of professional consultants as employed by King and Queen/Essex County.

1.7 Award of Contract

A. King and Queen / Essex County intends to award a contract for the complete system. However, King and Queen / Essex County specifically reserves the following rights, consistent with procuring a system that best meets the needs of King and Queen / Essex County and system users:

   1. King and Queen / Essex County reserves the right to accept or reject any portion of the (VENDOR) response.

   2. King and Queen / Essex County reserves the right to accept all or part of the (VENDOR) response depending solely upon the requirements and needs of King and Queen / Essex County.

3. King and Queen / Essex County reserves the right to seek clarifications of the (VENDOR) response submitted or specific aspects of the response prior to the award of the contract. After seeking such clarification, King and Queen / Essex County will allow (VENDOR) an opportunity to provide the requested clarification.

4. King and Queen / Essex County reserves the right to adjust item quantities and/or reconfigure the communications system in the best interest of King and Queen / Essex County subsequent to award of the contract.

1.8 Detailed Design (60 calendar days after contract award)

(VENDOR) shall submit the Detailed Design package within 60 days after contract award, which shall include the following:

A. Any updates to previously submitted design information

B. System block diagrams

C. Radio channel plans

D. Cutover plan

E. System operation and maintenance manuals for all equipment

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

G. Site installation drawings, including room layouts, all cable runs, and grounding

H. Equipment rack/cabinet elevation diagrams

I. Tower drawings including antenna and coaxial cable loading information, antenna center line heights, and any other equipment mounted on the tower

J. (VENDOR) shall submit a Draft Staging Acceptance Test Plan (SATP) for County review, outlining a comprehensive series of tests that will demonstrate proof of performance and readiness for shipment.

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

1.9 Detailed Design Review (60 calendar days after contract award)

A. The County shall conduct a detailed design review meeting to allow (VENDOR) to present the system design for review and approval.

B. The detailed design review will allow (VENDOR) to explain how all requirements will be met.

C. King and Queen / Essex County shall have 15 business days to approve the detailed design documents provided by (VENDOR).

D. The detailed design review shall be considered the last step prior to ordering and/or manufacturing equipment. Upon approval of the detailed design by King and Queen /

Essex County (VENDOR) should begin ordering and manufacturing system equipment. King and Queen / Essex County shall not be liable for any equipment ordered, or manufactured prior to approval of the detailed design.

1.10 System Shipping/Delivery

A. (VENDOR) shall submit a Bill of Materials / packing list with two copies for each shipment of equipment. The packing list shall include the following information at a minimum for each component included in the packaging:

1. Manufacturer
2. Model Number
3. Serial number
4. Unique identification of the package containing the item

B. All items shipped by (VENDOR) or their suppliers will include the above information in a barcode format.

2. Radio Communications System Requirements

2.1 Overview

A. (VENDOR) shall propose a complete 450 MHz, Project 25, Phase 2 Time Division Multiple Access (TDMA) trunking radio communications system designed to provide a capacity allowing for better than 1% Grade of Service (GoS).

B. (VENDOR) shall base the GoS on number of user groups, subscriber count, existing fleet mapping and typical public safety standards utilized in determining GoS requirements.

C. (VENDOR) shall detail the GoS provided and provide calculations employed to determine the GoS.

D. The system shall contain a ring protected microwave backhaul network providing 200 Mbps throughput and meet 99.999% reliability.

E. The systems shall provide 95% portable on the street radio coverage throughout the County as described in Section 2.6.

F. The system shall include a dispatch console subsystem and network management subsystem.

G. The system shall provide the following additional features capability:

1. AES Encryption
2. Over the Air Programming (OTAP)
3. Over the Air Rekeying (OTAR)

2.2 Project 25, Phase 2

A. The proposed radio system shall comply with the latest TIA/EIA/TSB-1 02, TIA/EIA¬102 and TIA-102 standards at the time of BAFO submission.

B. All system channels, repeaters and talkgroups shall be configured and licensed to operate dynamically in both Phase 1 Frequency Division Multiple Access (FDMA) and Phase 2 TDMA modes.

2.3 Redundancy and Survivability

A. The proposed radio communications system is intended to support mission critical operations; therefore, a high degree of redundancy and survivability is required. A network topology utilizing fault tolerance shall be incorporated to the greatest extent possible through a distributed and/or redundant architecture.

B. Redundancy is required for all system elements in which failure would result in a major failure of the system; single points of failure are not acceptable. Such elements include, but are not limited to the following:

1. System controllers and fixed site equipment

2. Simulcast control equipment
3. Backhaul network, including networking equipment such as routers and switches
4. Power systems
5. Network management system
6. Tower Top Amplifier

C. The system shall include several modes of degraded operation, known as failure modes. The system shall be capable of automatic activation of failure modes in the event of a failure. Additionally, the system shall switchover to a failure mode gracefully. Failure modes shall include the following scenarios at a minimum:

1. Loss of single site
2. Loss of multiple sites
3. Loss of system controller
4. Loss of simulcast control equipment
5. Loss of a channel
6. Loss of Tower Top Amplifier
7. Loss of microwave path/equipment

D. (VENDOR) shall explain each failure mode and how it affects system performance.

2.4 Expansion

A. The systems shall be expandable by adding additional hardware and/or software to increase coverage, capacity, or features. Where possible, (VENDOR) shall propose equipment such that the system is easily expandable by a minimum factor of 20%. For example if a transmitter combiner requires five ports for the system design, a 6-port combiner should be provided for ready expansion.

B. (VENDOR) shall list the system expansion capabilities for the following:

1. Total frequency channels
2. Simulcast cells
3. Sites per simulcast cell
4. Multicast/Individual repeater sites
5. Unit IDs
6. Affiliated Users
7. Talkgroups
8. Dispatch Positions

2.5 Site Selection

A. (VENDOR) shall use King and Queen / Essex County's existing communications sites to the greatest extent possible. The preferred order of site selection shall be; current tower sites utilized by the County, existing tower sites not currently utilized, then County owned land.

B. The total number of tower sites shall be determined by the total number of sites required to meet the coverage guarantee as defined in Section 2.6 Coverage

C. (VENDOR) shall verify that any existing sites selected for use have sufficient space available for antenna and ancillary equipment to be mounted on the tower/structure. In the event (VENDOR) proposes a location on the tower/structure, which is not available, (VENDOR)' guarantee of coverage shall not change even though an alternative design may be required.

D. In the event an existing commercial tower location is to be utilized, (VENDOR) shall provide King and Queen / Essex County with lease costs for tower space and ground space required to support the communications system. Additionally, (VENDOR) will exercise due diligence to verify the tower elevations they propose are available and the tower can support the proposed equipment.

2.6 Coverage

A. The radio systems design shall serve the geographical boundaries of the County with 95% portable on the street coverage, with 97% reliability, at a Delivered Audio Quality (DAQ) of 3.4 or better.

B. Any uncovered areas (i.e., the uncovered 5%) shall not include the major highways or highly populated areas within the County.

C. Coverage design, implementation, and testing for the system shall adhere to the Telecommunications Industry Association (TIA) Telecommunications Systems Bulletin (TSB) #88-C .

D. RF coverage is defined as the digital Bit Error Rate (BER) that provides a minimum Delivered Audio Quality (DAQ) 3.4 audio signal for both outbound (talk-out) and inbound (talk-in) communications.

2.6.1 Coverage Model and Maps

A. (VENDOR) shall employ a suitable coverage prediction model using appropriate terrain and land cover data for the environment, and shall include a detailed description of the propagation models used and the assumptions made in preparation of the maps. A brief description of the methodology the software used to calculate coverage shall also be included in the BAFO narrative.

B. (VENDOR) shall submit both talk-out and talk-back system composite coverage maps for all proposed design configurations. The maps shall be clearly labeled and shall show system gain calculations for each of the following:

1. Mobile radios – Standard dash or trunk mount with a unity gain antenna mounted in the center of the roof
2. Portable radios – Standard portable radio outdoors:
    a. Talk-out to a portable radio on hip with swivel belt clip
    b. Talk-back from a portable radio on hip with swivel belt clip

C. Coverage shall be depicted using a light transparent color or cross-hatching for those areas that meet or exceed the minimum coverage reliability threshold. The background map layer shall show the geographic boundary of the County, cities and towns, as well as major roads.

D. All maps must clearly delineate the difference between areas predicted to be greater than DAQ 3.4 equivalent coverage and areas that do not meet coverage requirements. (VENDOR) shall include the effects of simulcast interference (TDI) in all coverage maps (if applicable).

E. Coverage maps shall be provided in the BAFO in two formats:
1. 11”x17” (minimum) full color hardcopy format
2. In PDF file format on USB flash drive

F. Thirty meter U.S. Geologic Survey (USGS), NAD-83 terrain elevation data shall be used for coverage simulations. Alternatively, 3 arc-second data may be used where 30-meter data is not available.

2.6.2 Link Budgets

A. Link budgets shall be provided by (VENDOR), clearly defining the following minimum information, relating to each map and each site:
1. Base station / repeater RF power output
2. Antenna gain (transmit and receive)
3. Antenna down tilt (if applicable)
4. Transmit ERP
5. Receiver sensitivity
6. Tower top amplifier gain
7. Total antenna system gains, or losses
8. Antenna height
9. Mobile and portable antenna height for talk-out and talk-in
10. Mobile and portable RF output power

11. The configuration of field units (for example – talk-out to portable inside 12 dB loss buildings)

3. Radio Communications System Desired

3.1 Overview

Essex County wishes to update their aging VHF public safety system to a more modern P25 radio system that will provide better coverage and interoperability for their first responders. King and Queen County offered to share and expand their 450 MHz P25 Phase 1 conventional communications system located in King and Queen County. The system, as currently configured, will not completely provide the required coverage for Essex County but it can be expanded to do so. King and Queen and Essex have executed a memorandum of understanding for expanding the King and Queen system to provide the required coverage for King and Queen / Essex County. Because this system is an expansion of the existing King and Queen system, all requirements pertain to the expansion of that system will require the approval of King and Queen. All added equipment supplied shall be new, of high quality, and designed to provide high reliability to support mission critical communications. (VENDOR) shall provide specification sheets for all proposed equipment. The radio communications system shall consists of the following components:

A. System and site control equipment

B. Simulcast equipment

C. Receiver voting

D. Base Stations

E. Antenna systems

F. Dispatch Console Subsystem

G. Network Management Subsystem

3.2 System Control Equipment

A. The control equipment may use a distributed or centralized architecture.

B. The system control equipment shall be configured with a primary and redundant controller within the localities of King and Queen and Essex County. (VENDOR) shall propose geographically diverse controllers.

C. The system shall be configured such that a failure of the system control equipment does not completely disable the system. (VENDOR) shall describe system operation during a failure of the system control equipment.

D. The control equipment shall fully support APCO P25 functional requirements as outlined in Section 2.2, features, and performance objectives, including the Common Air Interface (CAI) and Inter-RF Subsystem Interface (ISSI).

E. (VENDOR) shall fully describe the manner in which the proposed system and site controllers function and operate.

3.3 Simulcast Equipment

A. (VENDOR) shall provide all necessary simulcast components and signal processing elements required to optimize voice quality in coverage overlap areas.

B. Simulcast control equipment shall be configured for geographically diverse redundant operation with primary and secondary simulcast controllers. (VENDOR) shall detail how the system will operate during a failure of the primary controller.

C. Simulcast control equipment typically relies on GPS receivers for timing and frequency stability. (VENDOR) shall detail how the system will continue to operate during a GPS failure.

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

E. Simulcast systems shall operate without the need for manual optimization and system / subsystem alignment. All alignment and adjustments shall be automated where possible (e.g., signal conditioning adjustments for channel banks, signal launch times at sites, etc.).

F. Simulcast equipment shall be integrated into the Network Management subsystem to allow for monitoring and remote configuration.

3.4 Receiver Voting

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

B. (VENDOR) shall provide geographically diverse voting equipment so that loss of a single site does not disable the entire network. (VENDOR) shall explain how the system will continue to operate during the loss of the primary voting site.

C. Receiver voting equipment shall be integrated into the Network Management Subsystem to allow for monitoring and remote configuration.

3.5 Base Station Equipment

A. General:

1. Base station equipment shall be solid state in design and function with standard site conditions for temperature, altitude, and humidity.

2. Base station equipment shall be integrated into the Network Management subsystem to allow for monitoring and remote configuration. Monitoring shall include, but not be limited to interrogating the base station equipment for; power amplifier temperatures, high/low voltage conditions and high Standing Wave Ratio (SWR). (VENDOR) shall detail which operating conditions are capable of being monitored.

3. The units shall be as compact as possible, with mounting configurations for standard relay racks or cabinets.

4. Base station equipment shall be controlled via IP connection.

B. Base station equipment shall comply with Part 90 of the FCC Rules and Regulations, as well as appropriate EIA and similar agency standards and shall be FCC type accepted for the 450-470 MHz frequency band.

C. Prior to implementation, (VENDOR) shall perform the following studies at each site:

1. Intermodulation analysis – (VENDOR) shall consider equipment from all tenants located at the proposed site, per FCC licensed information and observation of the equipment located at the site.

2. Maximum Permissible Exposure (MPE) study (per latest revision of Office of Engineering Technology (OET) bulletin 65) – (VENDOR) shall consider equipment from all tenants located at the proposed site, per FCC licensed information.

D. (VENDOR) shall resolve all issues predicted during the intermodulation analysis and MPE studies. (VENDOR) shall resolve any intermodulation problem identified following implementation, for a period of up to 12 months without degrading system coverage or performance, and at no cost to King and Queen / Essex County.

E. (VENDOR) shall include detailed specification sheets for all proposed equipment.

3.6 Antenna Systems

A. (VENDOR) shall propose all antenna system equipment necessary for a complete design.

B. Antennas shall be appropriate to provide the required coverage and meet applicable FCC rules and regulations.

C. Transmission line type and length shall be appropriate to provide the required coverage.

D. (VENDOR) shall fully describe expansion capacity for combiner and multicoupler systems.

E. (VENDOR) shall take precautions to ensure coaxial cable is sized to minimize the effects of Tower Top Amplifier (TTA) failures.

F. TTA failures shall not disable the receive function of any RF site. A failed TTA shall allow for the receive antenna to be operational in what is commonly referred to as “bypass mode”. If (VENDOR) proposes TTAs with redundant receive/amplifiers the “bypass mode” shall still apply.

G. (VENDOR) shall include detailed specification sheets for all proposed equipment, including, but not limited to antennas, receiver multicouplers, transmitter combiners, and tower top Amplifiers.

3.7 Gateway Devices

A. (VENDOR) shall supply each RF site and dispatch center with the necessary number of gateway devices to allow for connection of four legacy/interoperable stations to the network and control of the eight stations by the dispatch console subsystem.

B. Any device connecting a gateway device will have its audio recorded on the logging recorder.

C. Gateway stations will be capable of being patched to any P25, or conventional resource.

D. (VENDOR) will ensure integration of the customer provided SyTech RIOS State Gateway device at each dispatch location to the system.

3.8 Site DC Power

A. Remote RF Site Equipment shall be powered by -48 volt DC power plant, batteries and rectifiers.

B. The DC power plant and any required UPS or inverter shall be capable of an 8-hour runtime at 100% load

C. Individual breakers shall be supplied for each piece of equipment

D. Rectifier modules shall be hot swappable modular type with N+1 redundancy

E. Rectifier modules shall be capable of on-line expansion

F. The DC power plant shall be capable of completely charging all batteries in less than 24 hours while equipment is operating at 100% load.

3.9 Dispatch Console Subsystem

A. The dispatch console is a critical link for public safety personnel. It is here that the dispatch operator must relay critical information from the public to public safety personnel in the field. At times, the dispatcher may be in stressful conditions with lives at risk. It is imperative that the configuration of the dispatch console be such that the operation of such console is second nature to the dispatch personnel. The dispatch console should provide the operator with as much information as necessary without the screen being cluttered and be easily navigated to perform necessary functions.

3.9.1 General Requirements and Features

A. Two P25 Phase 2 dispatch console positions shall be provided and installed at the Essex County dispatch center and two P25 Phase 2 dispatch consoles shall be provided at the King and Queen County dispatch center.

B. Dispatch Console Equipment (Operator Positions) shall be designed for placement on modular workstation furniture and provide operators with an ergonomic design permitting ease of operation over extended periods, typically 8-12 hours for each operator.

C. Console positions shall be able to acoustically cross-mute channels in order to eliminate acoustic feedback between operators.

D. The screen display design shall facilitate all dispatching functions from one display.

E. The screen display shall be very flexible, allowing authorized personnel the ability to determine which functions are available at each operator position.

F. New features and screen configurations shall be supported through software programming and not reconfiguration of hardware.

G. The system shall provide the capability to program, store, retrieve, and edit multiple, custom operator screens and configurations for each operator position.

H. Operator screen configurations and alias database shall be stored locally or on a centrally located server.

I. (VENDOR) shall be responsible for loading alias information for all existing and provided subscriber devices into the console's database.

J. The dispatch console shall display an alias name on screen when a unit with a radio ID stored in the alias database is transmitting.

K. Operator positions shall have the ability to decrypt and encrypt secure voice communications. Channels shall have a distinctive icon if encryption is being used for that channel.

L. Upon activation of an emergency alarm by field units, dispatch positions shall provide an audible alert, display ID of calling unit, and provide a visual alert of an emergency activation.

M. Operators shall have the ability to utilize a headset or stationary gooseneck type microphone for transmitting audio.

N. The dispatch console subsystem shall be interfaced to the 911 phone system via an IP-based connection allowing for complete integration.

O. The capability to converse on the telephone utilizing the same operator headset used for radio conversations shall be provided.

P. An instant recall option shall be provided allowing the operator to verify his or her recent traffic. Both telephony and radio traffic shall be available for playback.

Q. The console subsystem shall control the radio system via a networking interface; RF control stations will not be used as primary control of the radio system.

R. The console subsystem shall be integrated with the existing Computer Aided Dispatch (CAD) system.

S. (VENDOR) shall fully explain how the radio system will be integrated with the existing CAD system.

T. (VENDOR) shall explain what features will be provided and how an integrated CAD/Radio system will benefit the County's dispatch operations.

U. Dispatch consoles shall be able to monitor and transmit on all proposed and existing systems.

V. Consoles will be capable of end-to-end AES encryption

3.9.2 Trunked Requirements

A. Dispatch consoles shall be compatible with the proposed radio system. Dispatch consoles shall directly interface with single and multi-site trunked system controllers and shall allow interoperability between trunked and non-trunked channels in the system.

B. A transmit/receive audio level (Vu) meter shall be provided showing the level of transmitted voice. This meter should also indicate the level of receive audio present on the selected channel.

C. Operator positions shall have the ability to independently set each channel's volume level. Minimum audio levels should be capable of being set to avoid missed calls.

D. A control/indicator shall be provided to allow the operator to mute or un-mute audio from unselected channels. Selected audio and unselected audio shall be audible from separate speakers.

E. Dispatch consoles shall be equipped with an instant transmit switch for each talkgroup displayed.

F. In a trunked system with radio IDs, the Push-to-Talk (PTT) ID of the unit calling shall appear in addition to a call indicator. After the call is completed, the unit PTT ID shall remain displayed until the dispatch operator receives another call.

G. To aid dispatchers on a busy system, a list of the last 15 radio IDs shall be available in a recent call list.

H. In order to enhance dispatcher effectiveness in a PTT ID system, the various display modes available shall interact in the following manner:

   1. An operator shall be capable of setting up (and subsequently knocking down) an emergency call from the dispatch console position.

   2. An option shall be provided to allow private communication between a dispatch console operator and a radio user.

I. The console shall have the capability to temporarily mute unselected talkgroups. The unselected audio will unmute automatically after a programmable preset time. Mute shall be 20 dB minimum.

J. Dispatch consoles shall have the capability to patch two or more talkgroups together so users may communicate directly. Patched talkgroups shall require a single talk path resource.

K. Dispatch consoles shall have the capability to select multiple talkgroups for simultaneous transmit. Multi-select transmissions shall require a single talk-path resource.

L. If the dispatcher attempts to make a call on a trunked radio system connected to the dispatch consoles and all trunked channels are busy, a visual and audible alert will be initiated at the dispatch consoles.

3.9.3 Conventional Requirements

A. Dispatch equipment shall include an instant transmit switch for each conventional repeater channel and/or base station.

B. On conventional resources capable of operating on multiple frequencies and/or modes, a control and indicator shall be provided to select the desired transmit frequency and/or mode. The select channel function shall cause the associated channel to switch channels / modes by emitting an EIA function tone / guard tone sequence for tone remote controlled stations. Once a channel has been selected, the operator shall be able to transmit on this channel by pressing the footswitch or transmit button.

C. A transmit/receive audio level (Vu) meter shall be provided showing the level of transmitted voice. This meter should also indicate the level of receive audio present on the selected channel.

D. Operator positions shall have the ability to independently set each channel's volume level. Minimum audio levels should be capable of being set to avoid missed calls.

E. A control/indicator shall be provided to allow the operator to mute or un-mute audio from unselected channels. Selected audio and unselected audio shall be audible from separate speakers.

F. A control/indicator shall be provided allowing the operator to select multiple channels allowing the dispatcher the ability to broadcast to several channels at once.

G. Operators shall have the ability to patch two or more conventional repeaters and/or base stations together so users may communicate directly. Operator positions shall be equipped such that a minimum of eight simultaneous patches shall be available.

H. Operator positions shall have the ability to patch conventional resources and trunked resources.

3.9.4 Operator Position Equipment

A. All equipment supplied for use by the dispatch operators will be capable of withstanding the 24 hours a day, 7 days a week environment of a busy dispatch center.

B. Operator position display monitors will be a 23" LCD/LED, touchscreen.

C. Keyboards shall be a standard 101- key keyboard.

D. Operator functions shall be executed by positioning a screen pointer (cursor) over the appropriate icon and pressing the mouse button or by touching the monitor screen.

E. A high quality gooseneck microphone shall be provided for each operator position.

F. Two headset jack boxes and headsets are to be provided at each position allowing the operator to hear select audio via a headset and allow the operator to respond via a microphone attached to the headset. The jack boxes are to be equipped with manual volume controls on each side of the box, one for the telephone and one for the radio. This configuration is to allow a supervisor to plug into an active system to monitor the activity at that console position and further allow for independent volume control of the audio at that jack box. The headset plug inserted into the jack shall automatically disconnect the console's microphone and mute the select speakers

G. The existing 911 system shall be integrated into the console subsystem to allow the dispatcher to communicate via a single headset for telephony and radio conversations.

H. Radio traffic shall be muted from telephony sessions.

I. A heavy-duty footswitch shall be provided to allow the operator to key the selected channel hands free.

J. PCs supplied shall be capable of providing a Graphical User Interface (GUI) using the Microsoft Windows® 7 or Windows® 10 Operating system.

K. PCs supplied shall be based on present state of the art PC technology using solid state hard drive(s).

3.9.5 Console Networking Equipment

A. Expectations are that the common electronics equipment required of console networks of the past have been replaced with networking equipment including routers, switches and PCs. This equipment essentially ties the console subsystem back to the central control/Project 25 core network. (VENDOR) shall fully describe the console subsystem's networking environment.

B. The console networking equipment should not have a single point of failure.

C. Redundant routers and/or switches shall be utilized for networking the console subsystem and connectivity to the system's core network.

D. The console networking equipment and console positions shall send alarm information to the Network Management Subsystem (NMS). Alarms specific to the dispatch console subsystem shall be displayed at the console operator positions.

3.9.6 Console Backup System

A. In the event of console or console interface failure, a control station shall be provided at each console position that allows the dispatcher to access the network.

B. Backup control stations shall be connected to an outside antenna via a control station combining network, or individual antennas.

3.10 Voice Logger Recorder

A. (VENDOR) shall propose an IP-based networked Project 25 Phase 1/Phase 2 compatible digital logging recorder system.

B. The voice logger recorder shall be integrated into the existing 911 and administrative telephony systems to allow for recording and playback of 911 and administrative calls.

C. The logging recorder shall be equipped to archive radio traffic and telephony to various storage media including, but not limited to internal, Redundant Array of Independent Discs (RAID) Level 1 or greater hard drive storage, CD-R/W, DVD-R/W devices and/or Network Attached Storage (NAS) devices.

D. The logging recorder shall be capable of storing audio in variable bit rate, industry standard digital formats such as WAV, WMP, MP3, etc.

E. Client/server architecture utilized shall allow for the access, playback and transfer of digital audio files across a Transmission Control Protocol (TCP)/IP-over Ethernet network.

F. The logging recorder shall be constructed to meet the requirements of 24 hour, 7 day a week operation.

G. The logging recorder shall meet or exceed all FCC, IEEE, EIA/TIA and APCO standards.

H. (VENDOR) shall detail the maximum number of concurrent talkpaths capable of being recorded by a single recorder.

I. (VENDOR) shall detail the maximum number of concurrent playback licenses, and costs associated with each, for the supplied logging recorder device.

J. The ability of multiple search and playback techniques shall include, but not be limited to:

1. Console position
2. Subscriber unit ID
3. P25 emergency call activation
4. Talkgroup
5. RF channel (for conventional repeaters/base stations only)
6. Date and time

K. The logging recorder subsystem shall share the common timing reference with the system.

L. The logging recorder shall be capable of being mounted in an EIA/TIA standard 19” wide rack.

M. The logging recorder shall interface directly with the system for audio and P25 data. The County will not accept recorders that interface through the dispatch consoles or the console subsystem.

N. The logging recorder shall be equipped with dual power supplies.

O. The logging recorder shall be capable of individual user logon and various levels of access to channels and authorized permissions.

P. A total number of 10 concurrent licenses will be provide for playback and media creation.

Q. The logging recorder will be capable of storing 3 years of audio. (VENDOR) shall provide detail as to how the storage capacity was calculated.

R. The configuration of the logging recorder shall accommodate the recording of all talkgroups, both encrypted and non-encrypted.

3.11 Network Management Subsystem (NMS)

A. (VENDOR) shall propose a hierarchical Network Management System (NMS) capable of incorporating multiple management systems into a high-level management system that provides a single point to manage multiple subsystems.

B. The NMS shall display system status and alarm conditions and must provide the ability to remotely access the system to check the operational status and view alarms through the network. This includes the ability to:

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

C. Key elements of the NMS are:

1. Real time airtime usage
2. Real time monitoring of network element status
3. Real time status of network usage
4. Real time alarm management
5. Simple Network Management Protocol (SNMP) support allowing interfaces with higher-level network management systems.

D. (VENDOR) shall fully explain which Network Management applications require a license and which, if any can be accessed via a browser application

E. All systems and subsystems provided shall be monitored by the NMS.

F. NMS components include:

1. Network Management Terminals (NMT)
2. Remote Terminal Units (RTU)

3. Associated networking equipment

3.11.1 Network Management Terminals (NMT)

A. The NMT shall provide primary processing, display, and control of information to and from a variety of locations. The NMT shall display system status and alarm conditions. The NMT shall provide the ability to remotely access the system to check the operational status of the system and view alarms.

B. Network Management Terminals shall be provided for the following locations:

1. System Control/Core Sites
2. King and Queen / Essex County Dispatch Center

C. NMT shall meet the following general requirements:

1. Expandable software architecture shall be easily updated by adding software applications.
2. Hardware and software platform shall be PC based using current versions of hardware and software.
3. Both graphic and tabular displays shall provide instantaneous and comprehensive network status information.
4. The NMT shall provide full archiving and control functions.
5. All NMTs shall be licensed to operate the entire suite of management applications available to manage the system.
6. The NMT shall be designed to monitor a large cross section of equipment so that it can consolidate multiple alarm systems rather than just poll alarms from RTU locations.
7. The NMT must be capable of performing full management functions.
8. The NMT shall provide email notification of alarms.
9. The NMT shall provide alarm filtration and consolidation.

3.11.2 Remote Terminal Units (RTU)

A. RTUs shall be provided in sufficient quantities to monitor the entire network including:

1. Trunked and conventional radio network components
2. Site facilities including shelter, tower, lighting, power, generator, fuel level, site entry, and environmental (such as high-temperature)

3. Microwave radios, channel banks, etc.
4. Data network equipment including routers, switches, etc.
5. Other miscellaneous equipment

B. RTUs shall be fully compatible with the NMT supplied and provide complementary functionality wherever necessary to provide a complete working system.

C. RTUs shall support the following points:

1. Status/alarms – 48 minimum expandable to 256 points
2. Control outputs – 8 minimum expandable to 32
3. Analog inputs – 8 minimum expandable to 16 (optional)

D. RTUs shall support time stamp and system time synchronization.

E. Terminations for all points shall be provided on suitable terminal blocks providing ease of installation, testing, and maintenance.

4. Backhaul Network

4.1 Digital Microwave Network

A. The digital IP microwave network shall consist of either monitored hot standby (MHSB) or ring protected loop system. Unlicensed microwave is unacceptable. The microwave system shall be designed to achieve 99.999% overall availability. A ring protected loop system is preferred.

B. Split unit systems are not acceptable. Microwave radios will be of all indoor type.

C. Microwave links not ring protected shall be configured for monitored hot standby (MHSB) operation.

D. Microwave terminal equipment shall include transmitter, receiver, modem, power supply, automatic switching device, multiplexer, service channel(s), and all associated interconnections to provide a complete and functional System.

E. The radio shall deliver two-frequency, full duplex operation. Space diversity configurations are acceptable if necessary to meet reliability requirements.

F. The overall microwave backhaul network must support a minimum OC-3 bandwidth.

G. (VENDOR) must indicate packet latency and jitter performance of the microwave backhaul network. In addition, (VENDOR) must confirm that such performance is sufficient to accommodate all radio and dispatch communications traffic transported by the microwave backhaul network.

H. There must be no single point of failure within the IP network. Each site shall have redundant routers that support the monitored hot standby spurs or dual paths for loop-based sites. The failure of one router must not affect the performance of the overall network or of the individual site.

I. The network must reroute network traffic in less than 50-milliseconds (ms) in the case of a path or device failure. (VENDOR) must describe how the proposed System fulfills this requirement.

J. The microwave system must be designed to meet or exceed a two-way annual availability (BER = 1 0^-3) of 99.999% at the required capacity.

K. Each individual microwave link must be designed to meet or exceed a two-way annual quality performance (availability) of 99.9999% (BER = 10-6) at the required capacity.

L. (VENDOR) shall be responsible for all microwave frequency research, prior coordination and preparation of all associated FCC license applications and submittals on behalf of King and Queen / Essex County.

M. All RF paths shall be tested to demonstrate proper antenna alignment by measuring the net path loss between sites as measured at the equipment rack interface.

4.2 Microwave Backhaul Network Engineering

A. (VENDOR) shall provide preliminary microwave path details including centerline mounting heights recommendations, fade margins, antenna sizes, system gains and system losses, and path profiles.

B. (VENDOR) shall conduct physical path surveys to assure that all proposed paths meet proper clearance criteria.

C. (VENDOR) must provide modified antenna centerline mounting height recommendations, if required, based upon the information gathered during the physical path surveys and site visits.

D. (VENDOR) must include fade margin calculations with the BAFO, showing the preliminary antenna sizes, system gains, and system losses.

E. (VENDOR) must provide radomes for each microwave antenna.

F. The proposed microwave backhaul network equipment must be type accepted for licensing under Part 101 of the FCC Rules and Regulations.

4.3 Microwave Antenna System

A. Microwave antennas shall be compatible with the radio frequency bands and conform to applicable FCC requirements. Solid parabolic type, Category A antennas shall be used in accordance with FCC Part 101.115.

B. All mounting brackets, connectors and other hardware shall be supplied as necessary for a complete installation.

C. Ice shields shall be provided and installed to protect each microwave dish from falling ice.

4.4 Microwave Backhaul Network Management

A. (VENDOR) shall fully describe alarm, monitor, and control capabilities of the microwave terminal equipment, including capacity for external alarms (e.g., door alarms, generator, etc.).

B. (VENDOR) shall provide an Element Management System (EMS) with sufficient alarm, control, and tracking capabilities for the proposed microwave network, to be integrated with the system Network Management System. The system shall be capable of remotely monitoring equipment status and performance from all sites.

C. The NMS shall be fully compatible with the integrated NMS requirements defined in Section 3.11 – Network Management System (NMS) of this BAFO Requirement.

D. The overall network shall have a common end-to-end management and configuration tool capable of complete control of all network elements. The tool shall be able to support building an end-to-end path without requiring manual configuration of each intermediate device. Graphical display of resulting configurations is preferred:

1. Automated error checking shall be included to prevent typical configuration problems such as oversubscription of a link. The tool shall alert the user when such errors occur.

2. The management tool shall perform automated backups of all device configurations and include a change log of all changes made to a device over time.

3. The management tool shall support a hierarchical user authorization mechanism allowing assignment of various roles to users and those users can act on a specific subset of devices.

5. Subscriber Equipment

5.1 Overview

A. Subscriber equipment includes all non-fixed user equipment, such as:

1. Portable radios
2. Mobile radios
3. Control stations

B. (VENDOR) shall provide unit pricing for all user subscriber equipment and accessories.

C. All subscriber equipment provided shall accommodate 450 MHz operation.

5.2 General Requirements

A. All subscriber equipment shall be of high quality and intended to provide high reliability under heavy use in severe environments. Equipment must be FCC type accepted in accordance with FCC Part 90 rules and regulations.

B. All subscriber equipment shall meet MIL-STD-810 C, D, E, and F.

C. All subscriber equipment shall be software programmable.

D. (VENDOR) shall be responsible for programming and installation of all subscriber units. (VENDOR) shall provide multiple programming sessions of subscriber units at no additional cost up to Final System Acceptance.

E. (VENDOR) shall be responsible for removal of any existing subscriber equipment. Removal of equipment may coincide with the time of installation of new subscriber equipment or after system cutover, whichever fits the needs of the County.

F. All subscriber equipment shall support the following operating modes:

1. Conventional analog FM network
2. Conventional analog FM off-network
3. Conventional P25 Phase 1 network
4. Conventional P25 Phase 1 off-network
5. Trunked P25 Phase 1 network
6. Trunked P25 Phase 2 network

5.2.1 Portable Radios

A. Essex County has estimated the quantities of portable radios. For the purpose of this BAFO, (VENDOR) shall provide pricing with the assumption that the County will purchase the following:

1. 105 Portables

2. 60 Vehicle chargers
3. 50 Desk top chargers
4. 105 Speaker Microphones
5. 6 multi bank chargers

B. King and Queen County has estimated the quantities of portable radios requiring upgrade to P25 Phase 2. For the purpose of this BAFO, (VENDOR) shall provide pricing with the assumption that the County will purchase the following:

1. 200 Portables
2. 110 Vehicle chargers
3. 100 Desk top chargers
4. 200 Speaker Microphones
5. 6 multi bank chargers
6. 22 Trunking Key/Phase 2 Key Upgrades to existing TM9400 subscribers

C. As an OPTION, (VENDOR) shall propose radios certified as intrinsically safe.

D. (VENDOR) shall provide the highest tier product available, highly reliable and intended for mission critical operations. Pricing shall be provided for a minimum of three models:

1. Model 1: Basic model, typically identified with no keypad or display
2. Model 2: Mid model, typically identified with limited keypad and display
3. Model 3: Advanced model, typically identified with full keypad and display

E. Features:

1. Full compliance with P25 features and operation
2. PTT button
3. Top-mounted on/off volume knob
4. Talkgroup/channel selector
5. Emergency button, protected from inadvertent activation
6. Alphanumeric display (on applicable models), minimum of 8 characters
7. Transmit indicator
8. Over the Air Programmable (OTAP)
9. Over the Air Rekey (OTAR)
10. Send and receive text message
11. AES Encryption

F. Battery:

1. (VENDOR) shall propose batteries without cadmium. Pricing shall be provided for the following:
    a. Lithium-ion
    b. Lithium Polymer
2. As an OPTION, (VENDOR) shall propose batteries certified as intrinsically safe.
3. Batteries shall provide a minimum operational use of twelve hours based on a 5-5-90 duty cycle.
4. Recharge time to full capacity shall not exceed one hour.
5. (VENDOR) shall provide detailed specifications for all batteries proposed, including the following at a minimum:
    a. Battery life
    b. Total battery life-cycle expectancy
    c. Recharge time
    d. Dimensions
    e. Weight
    f. Warranty

G. Accessories: (VENDOR) shall provide OPTIONAL pricing for all accessories, including the following at a minimum:

1. Data cables
2. Battery chargers:
    a. Single-bay battery charger
    b. Multiple-bay battery charger
    c. Vehicular charger
3. Alternate antennas
4. Remote speaker microphone
5. Remote speaker microphone with antenna
6. Headset:
    a. Wired
    b. Wireless/Bluetooth
7. Carrying cases/belt clips

8. GPS

H. (VENDOR) shall provide detailed equipment specifications for all proposed portables and accessories, including the following information:

1. Radio dimensions
2. Radio weight with battery
3. Antenna type
4. Frequency channel capacity
5. General features, Transmit/Receive parameters, and mechanical specs

I. Multiband portable radios:

1. As an OPTION, (VENDOR) shall propose multiband portable radios capable of operating in the following frequency bands:

   a. VHF: 136 – 174 MHz

   b. UHF: 380 – 520 MHz

   c. 700/800 MHz: 762 – 870 MHz

2. (VENDOR) shall provide detailed specifications for radios and all accessories.

5.2.2 Mobile Radios/Control Stations

A. Essex County estimated the quantities of mobile radios needed. For the purpose of this BAFO, (VENDOR) shall provide pricing with the assumption that the County will purchase a minimum of 63 trunk mount mobile radios, 6 with dual heads.

B. King and Queen County estimated the quantities of upgrades to existing mobile radios needed to Phase 2/Trunking. For the purpose of this BAFO, (VENDOR) shall provide pricing with the assumption that the County will purchase a minimum of 52 trunk mount mobile radios, 14 with dual heads.

C. (VENDOR) shall provide pricing for a minimum of three tiers:

1. Model 1: Basic model, typically identified with no keypad or display
2. Model 2: Mid model, typically identified with limited keypad and display
3. Model 3: Advanced model, typically identified with full keypad and display

D. Mobile radios shall be supplied complete with microphone, external speaker, cables, fusing, mounting hardware, coaxial cable and unity gain antennas to provide for a complete installation.

E. Control station radios shall be supplied complete with desk microphone, speaker, cables, coaxial cable, antennas, and antenna mounts to provide for a complete working package and 2 remote stations – control stations “in box” that can be relocated as needed

F. (VENDOR) shall provide pricing for dash mounted units and remote mounted units.

G. Features:

1. Full compliance with P25 features and operation
2. Remote speaker microphones
3. Front-mounted on/off volume knob
4. Talkgroup/channel selector
5. Emergency button, protected from inadvertent activation
6. Alphanumeric display
7. Transmit indicator
8. Over the Air Programmable
9. Over the Air Rekey
10. Send and receive text message
11. AES Encryption

H. Accessories – (VENDOR) shall provide OPTIONAL pricing for all accessories, including the following at a minimum:

1. Cables:
   a. Data cables
   b. Extension cables
   c. Adapters
   d. Power cables
2. Antennas
3. Dual Control Head
4. External Speakers
5. Public address kits
6. Remote speaker microphones
7. Desktop microphone (control stations only)

I. (VENDOR) shall provide detailed equipment specifications for all proposed mobiles and accessories, including the following information:

1. Radio dimensions
2. Radio weight with battery
3. Antenna type

4. Frequency channel capacity

5. General features, transmit/receive parameters, and mechanical specifications

J. Multiband mobile radios:

1. As an OPTION, (VENDOR) shall propose multiband mobile radios capable of operating in the following frequency bands:

   a. VHF: 136 – 174 MHz

   b. UHF: 380 – 520 MHz

   c. 700/800 MHz: 762 – 870 MHz

2. (VENDOR) shall provide detailed specifications for radios and all accessories.

6. Facilities and Infrastructure Development

6.1 General

A. (VENDOR) shall use existing site/structure infrastructure to the greatest extent possible.

B. (VENDOR) shall identify and propose any additional work necessary, including, but not limited to:

1. Towers
2. Shelters
3. Backup power
4. Site preparation
5. Fencing

C. (VENDOR) shall be responsible for updating all existing sites that are part of the proposed system to become compliant with their provided grounding standards. (VENDOR) shall be responsible for ensuring all site conditions requiring updating are accounted for.

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

E. (VENDOR) shall be responsible for any issues related to site selection and will be responsible for resolving any issues related to site permitting or zoning.

F. Code Compliance:

1. Installation of all electrical equipment, power distribution, lighting assemblies and associated wiring shall comply with the most recent edition of the National Electric Code (NEC) and Occupational Safety and Health Administration (OSHA) regulations.
2. All electrical equipment shall be listed or approved by Underwriters Laboratories (UL).
3. (VENDOR) and any contractor employed by (VENDOR) shall comply with all local codes and industry best practices and guidelines stipulated in Section 1. 4.1, Standards and Guidelines.

G. (VENDOR) shall assume total responsibility for maintaining liability insurance covering the following items:

1. Project design
2. Implementation
3. Licensing
4. Shipping

5. Receiving

6. All site work required

7. Any items required for (VENDOR) or any required sub-vendors or subcontractors.

H. Prior to any excavations, (VENDOR) or its subcontractor shall follow appropriate procedures outlined at the following website: www.call81 1 .com.

I. (VENDOR) will coordinate with utility companies for all utility related items, such as electrical service hookups and disconnects.

J. During preliminary design, (VENDOR) shall provide detailed drawings including all structures and foundations, sealed by a professional engineer registered in the state of Virginia:

1. Detailed dimensioned drawings showing all system components and locations.

2. Drawings and/or specifications shall describe any auxiliary equipment. 3. Manufacturer slick sheets of all equipment used shall be provided.

K. Concrete

1. For all foundations and concrete work, (VENDOR) or its subcontractor will provide to the Project Engineer a test sample of each mix of concrete demonstrating that is has been tested for compliance with the foundation specifications set forth by the requisite site engineer. Written reports certifying the strength of the concrete are to accompany each test cylinder.

2. If any concrete used in the foundation does not meet specifications, (VENDOR) or its subcontractor will be required to remove the foundation and pour a new foundation using compliant materials, at no expense to the owner.

L. All control functions and alarms from towers, shelters and backup power shall be interfaced to the NMS detailed herein, for remote control and monitoring.

6.2 Towers

A. General:

1. If (VENDOR) determines additional towers are required, or existing towers must be replaced, (VENDOR) shall propose a self-supporting tower.

2. Towers proposed will be Class III towers designed for the appropriate exposure and topographic categories.

3. Any tower manufacturer supplying a tower(s) for this system will guarantee structural integrity of the tower for a period of not less than 20 years from the date of acceptance.

4. (VENDOR) shall be responsible for all geotechnical analyses (soil testing) and proper foundation design.

B. Tower Loading:

1. The tower and foundation shall be designed for all proposed equipment, legacy equipment, appurtenances, ancillary equipment, initial antenna loading plus 100% future antenna system growth, without addition to or modification of the finished tower or foundation.

2. Designed loading shall also consider two typical cellular carrier antenna arrays near the top of the structure for future growth or leasing opportunities.

3. The proposed tower structure shall be designed and installed in accordance with the latest revision of the ANSI/EIA-222 standard.

C. Existing towers:

1. (VENDOR) shall perform a structural analysis. If drawings are unavailable, (VENDOR) shall also be responsible for any tower mapping services required for the structural analysis.

2. Structural analysis shall be performed on existing towers according to the ANSI/TIA-222G standard, or latest version at the time of the structural analysis.

3. Structural analysis shall include existing and proposed equipment.

4. (VENDOR) shall provide the completed structural analysis reports to King and Queen / Essex County.

5. In the event a tower fails the structural analysis, (VENDOR) shall be responsible for modifying the tower to correct the deficiencies. Following the correction of any deficiencies, (VENDOR) shall provide a passing structural analysis to King and Queen / Essex County detailing the tower modifications.

D. Proposed towers shall include the following:

1. Ice bridge – A horizontal transmission line ice bridge, extending from the tower cable ladder to the equipment building entry port, shall be provided. The ice bridge will be self-supported and not directly connected to the tower or the shelter.

2. Transmission Line Support – A vertical transmission line support system shall be provided to securely attach the antenna transmission lines. Holes shall be provided in the tower support members, tower hanger adapter plates or separate ladder structures to allow installation of snap-in cable hangers and bolt-in cable hangers at maximum 3-foot intervals. The mounting holes shall be precision punched or drilled and sufficiently separated to accommodate the snap-in or bolt-in hangers.

3. Climbing Access – A ladder, beginning at a point at least ten feet off the ground, shall be provided as an integral part of the tower to permit access by authorized personnel. The tower shall be equipped with an OSHA approved anti-fall safety device in accordance with EIA-222. This device must not interfere with the climber's ease of reach by hand or foot from one rung of the ladder to the next,

either going up or coming down. Two safety-climbing belts shall be supplied with each new tower.

4. Lighting:

   a. Tower lighting shall be supplied as required by the applicable determination as issued by the FAA for this project and fully compliant with FAA AC 70/7460-1 K or latest revision.

   b. The system control circuitry shall provide synchronization and intensity control of the obstruction lighting system and shall monitor the overall integrity of the lighting system for component failures or improper operation.

   c. (VENDOR) or subcontractor shall wire all alarms to a contractor provided Type 66 block located in the communications shelter or equipment room. All alarms shall be clearly labeled.

5. A lightning ground rod shall be installed at the very top of the tower to extend at least two feet above the top of the tower or lighting fixture.

6. Labeling shall be clearly provided near the base of all new towers for the following:

   a. Make

   b. Model

   c. Serial number

   d. Tower height

   e. Latitude and longitude

   f. FAA and FCC identification numbers (if applicable)

E. Construction:

1. All welding must be done in the factory prior to the galvanizing process. Field welding is not acceptable.

2. The tower shall be constructed of high-strength steel. All components and hardware being hot dip galvanized with zinc coating per EIA standards after fabrication. A zinc coating shall be permanently fused to the steel, both inside and outside, so all surfaces are protected and no painting is required for rust protection.

3. Prior to galvanizing, each piece of steel and every weld is to be deburred and smooth finished.

4. (VENDOR) shall carefully examine and study existing site conditions, difficulties in accessing sites for tower delivery and installation will be the responsibility of (VENDOR). The County will not consider later claims for additional compensation

because of unanticipated labor, equipment or materials required resulting from difficulties encountered during tower delivery or installation.

F. Final Testing and Acceptance -- Upon completion of the work, documentation detailing final inspection and testing shall be submitted, documenting the following:

1. Steel structure:

   a. Vertical alignment and plumbness

   b. All bolts tight and torqued to specification

   c. No damaged or missing structural members

   d. All surface scratches and damage to the galvanization will be repaired using the hot stick process.

   e. No signs of stress or vibration

   f. All climbing ladders, and other devices installed correctly

   g. Labels and tags

2. Foundation:

   a. Concrete finish with no cracks or blemishes

   b. Grouting, if used, will have drain holes if the tower uses hollow leg construction or monopole design

   c. Backfilling and grading

3. Grounding:

   a. Verify lugs and CADWELD®s

   b. Ground resistance test and record

   c. Ground lightning rod installed at top of tower

4. Ice Bridge: Installed per specification

5. Lighting and controls:

   a. Inspect conduit and wiring installation

   b. Verify proper lamp operation

   c. Verify alarm contact operation

   d. Verify labeling

6. Photographs:

   a. Overall structure from N, E, S, W

   b. Footers

c. Grounding

6.3 Shelters

A. General:

1. (VENDOR) shall propose a new equipment shelter for all RF site locations that do not currently have acceptable shelters..
2. The shelter shall be a prefabricated, preassembled shelter. Shelter construction may be concrete, and/or aggregate materials.
3. The shelter shall consist of a single equipment room.

B. Size:

1. Minimum shelter size shall be 10’ x 12’, with a minimum interior height of 9 feet.
2. (VENDOR) shall be responsible for determining if a larger shelter size is required based on proposed equipment and legacy equipment to be installed.

C. Foundation:

1. The foundation for the shelter shall consist of concrete piers or a poured concrete slab constructed by (VENDOR) or approved subcontractor that properly supports and secures the shelter. Foundation drawings recommended by the shelter manufacturer shall be the criteria for foundation construction.

D. Flooring:

1. (VENDOR) shall propose a structure with floor and/or solid foundation featuring a minimum uniform load rating of 200 pounds per square foot with no more than 3,000 pounds over any four-square-foot area. This rating shall be increased in sections as necessary to support heavy weight equipment. If delivered assembled with floor, the floor shall exhibit a minimum 90 pounds per square foot uniform live load capacity during lifting.
2. Floors shall be insulated to a minimum R-1 1 rating. Insulation shall be secured in place to prevent shifting during construction and transportation.
3. Exterior covering of the floor shall be included to prevent rodent penetration.
4. The floor shall be covered by a high quality, industrial / commercial grade asphalt or vinyl tile. All edges shall be covered by wall molding.

E. Walls:

1. Walls shall be constructed to a minimum 120 MPH wind loading, including overturning moments.
2. Bullet Proof: Walls and doors shall withstand the effects of bullets or other projectiles equivalent to a 30.06 high power rifle load fired from a distance of 50

feet with no penetration to the inner cavity of the wall. No interior damage shall be sustained including insulation, interior walls, etc.

3. The outside walls shall be finished concrete or an aggregate composition.

4. A wall feed-through with 12 each, 4-inch openings shall be provided on the tower side of the building to accommodate elliptical waveguide and coaxial transmission lines. The openings shall be properly booted to provide a good weather seal.

5. The inside walls shall be finished with minimum 5/8-inch plywood (or equivalent) trimmed with coordinated molding to allow mounting of panels, blocks, etc.

6. High performance insulation shall provide a minimum insulation factor of R-11.

F. Roof:

1. The building roof shall support a minimum 100 pounds per square foot uniform live load.

2. The roof is to be pitched to facilitate runoff of water.

3. The shelter roof shall withstand the impact of ice falling from the adjacent tower without suffering any damage, or shall otherwise be protected from such damage. (VENDOR) shall describe how this requirement will be met.

4. High performance insulation shall provide a minimum insulation factor of R-19.

G. Door:

1. Shelters shall have one 42” x 84” insulated door, with three stainless steel tamperproof hinges, passage style lever handle, deadbolt lockset and fiberglass weather hood or awning. The door shall be equipped with a hydraulic door closer.

2. The exterior door shall be of aluminum or steel (stainless or galvanized) construction with a finish to match the building finish.

3. The door shall withstand the effects of bullets or other projectiles equivalent to a 30.06 high power rifle load fired from a distance of 50 feet with no penetration to the inner cavity of the door. No interior damage shall be sustained including insulation, interior walls, etc.

4. The doorsill shall be of stepped construction to prevent water intrusion at the bottom of the door or around the doorframe. The doorframe shall have a weather seal around the door to minimize air and water intrusion.

H. Finishes:

1. (VENDOR) shall describe the interior and exterior finishes. King and Queen / Essex County shall select colors and finishes from samples provided by (VENDOR) or its subcontractor.

2. All joints shall be sealed with a compressible, resilient sealant.

I. AC Power System:

1. (VENDOR) shall deliver the building complete with a 200-ampere capacity, 240 volts, single-phase electrical panel box with a ground bar.

2. This panel shall be equipped with a 200-ampere capacity main circuit breaker used to supply power for all electrical functions related to the site.

3. Overall panel size shall be determined by the need to provide the number of individual breakers required plus a reserve of at least six 240 Volt slots.

4. Receptacles:

   a. Each radio equipment unit (or rack) shall be supplied with two 20 Amp circuits, each terminated at a typical NEMA 20 twist lock receptacle. Receptacles shall be mounted to the side of the overhead cable tray.

   b. Service receptacles shall be mounted on the walls at 6-foot intervals or less.

   c. One weatherproof GFI exterior power receptacle shall be provided with each shelter, to be mounted near air conditioning units.

   d. A power receptacle shall be located near the microwave dehydrator to power the unit.

   e. Each receptacle shall be fed from an individual breaker. The feeding breaker shall be identified at the receptacle and the receptacle shall be identified at the breaker. All breakers or circuits shall be 20 Amp, unless otherwise noted.

J. Power Line Surge Suppression:

1. An AC surge protector shall be provided and installed inside the shelter.

2. An acceptable unit shall be an in-line type such as the AC Data Systems “integrated load center”. An alternate unit must meet or exceed all of the capabilities of this model unit.

3. Minimum surge protector requirements

   a. Built-in redundancy of dual stages per phase with filtering

   b. Surge energy shunted to ground, not to neutral

   c. Front panel indicator lamps

   d. Remote / local status contacts

   e. Fusible link protected so as not to interrupt power

   f. Field replacement protection blocks, fuses, if needed

   g. UL listed components

   h. EMI/RFI filtering per Mil-STD-220

i. The unit shall be capable of handling the full 240 Volt, 200 Amp capacity of the electrical system

K. Wiring Methods:

1. All wiring noted on the site drawings or otherwise included by (VENDOR) shall be installed in conduit or ductwork. Where no protection method is specified, conduit shall be used.

2. All conduits and ducts shall be securely surface mounted and supported by approved clamps, brackets, or straps as applicable and held in place with properly selected screws. No wiring shall be imbedded inside any walls, floor or ceiling. Entrance power, outside lighting, air conditioning outlet and Telco are the only wiring that may penetrate shelter walls or floor.

3. All wire raceway, conduit, etc., is to be mechanically joined and secured.

4. Flexible steel conduit or armored cable shall protect wiring connected to motors, fans, etc., and other short runs where rigid conduit is not practical.

5. Unless otherwise specified, all power wiring shall be a minimum 12 AWG size solid copper conductors with insulation rated for 600 Volts alternating current (AC).

6. One 4’ x 6’ x 3/4” TELCO board shall be installed.

L. Light Fixtures:

1. Ceiling mounted four-foot LED light fixtures (two bulbs per fixture) with RFI supression be supplied for the equipment shelters. A sufficient quantity of light fixtures shall be supplied to provide a uniform light level throughout the building of 150 foot-candles at 4 feet above the floor.

2. Light fixtures shall be fed as a gang from a common breaker and controlled by an on/off switch near the door.

M. Outdoor Lighting:

1. An exterior 800 Lumen LED wall mounted light shall be mounted by the front entrance of the shelter.

2. The exterior lighting system shall be fed from a separate, appropriately rated breaker and light switch by the door.

N. Heating, Ventilation, and Air Conditioning (HVAC):

1. (VENDOR) shall provide an HVAC system for each shelter proposed. (VENDOR) shall propose dual AC units with lead/lag controller. Each AC unit shall be sized for 100 percent of the buildings required cooling capacity, as determined by the BTU analysis.

2. (VENDOR) shall perform BTU analysis (heat load calculations) for all shelter equipment during preliminary design to verify HVAC system size. All calculations shall include a 50% expansion factor, and all assumptions regarding power consumption, duty factor, and heat loading shall be thoroughly explained.

3. Each unit shall be capable of maintaining an inside ambient temperature range between 65 and 85 degrees F. Each unit shall be sized to maintain temperatures inside the shelter at 70 degrees F when exterior temperatures go as high as 100 degrees F.

4. The HVAC system shall be controlled by a wall mounted thermostat. The thermostat shall turn the heater on when the temperature inside the shelter drops to 65 degrees F and off when it rises to 68 degrees F. It shall turn on the air conditioner when the interior temperature reaches 78 degrees F and off when the temperature drops below 75 degrees F. Thermostat control shall be adjustable within the range of 45 to 85 degrees F.

O. Antenna Cable Entry -- A bulkhead panel shall be supplied to accommodate coaxial transmission lines between 1/2-inch and 1 5/8-inch diameter elliptical waveguides. A minimum of 12 transmission lines shall be accommodated with 4-inch openings. The building manufacturer shall seal the conduits into the wall to assure that they are watertight.

P. Cable Tray -- All new shelters will be equipped with cable trays. (VENDOR) shall install a minimum 18-inch wide cable tray system above the equipment.

Q. Shelters shall be supplied with at least two 10-pound CO2 fire extinguisher, an approved eyewash station and first aid kit.

R. Site access, shelter delivery and installation shall be the responsibility of (VENDOR). (VENDOR) should therefore carefully examine and study existing site conditions. The County will not consider later claims for additional compensation for unanticipated labor, equipment or materials required resulting from difficulties encountered during shelter delivery or installation.

6.4 Generator and Automatic Transfer Switch (ATS)

Specifications and requirements for standby power systems to supply electrical power in the event of failure of normal supply, consisting of a liquid cooled engine, an AC alternator and system controls with all necessary accessories for a complete operating system, include but are not limited to the items as specified.

A. (VENDOR) shall provide an emergency generator system at each new site and evaluate each existing RF site for appropriate backup power.

B. (VENDOR) shall perform electrical loading analysis for shelter equipment, including HVAC subsystems, during preliminary design to verify generator size and fuel tank capacity. All electrical loading calculations shall include a 50% expansion factor, and all assumptions regarding power consumption and duty factor shall be thoroughly explained.

1. In the event loading is less than 50 kW, a 50 kW generator will be proposed.
2. Generators will be powered by liquid propane.

C. In the event of a commercial power outage, the emergency generator shall provide power to the entire shelter without system outage.

D. Quality Assurance – The system shall be supplied by a manufacturer who has been regularly engaged in the production of engine-alternator sets, automatic transfer switches, and associated controls for a minimum of 10 years, thereby identifying one source of supply and responsibility.

E. The generator system and all accessories and ancillary equipment shall comply with the following standards:

1. NFPA 37 Flammable and Combustible Liquids Code
2. NFPA 55 Standard for the Storage and Handling of Compressed Gases
3. NFPA 70 with particular attention to Article 700, “Emergency Systems”
4. NFPA 110 Requirements for Level 1 Emergency Power Supply System
5. NFPA 101 Code for Safety to Life From Fire in Buildings and Structures
6. ANSI/NEMA MG 1 – Motor and Generators
7. ANSI/NEMA AB 1 – Molded Case Circuit Breakers
8. ANSI/NEMA 250 – Enclosures for Electrical Equipment (1,000 volts maximum)

F. Labeling and Identification – All wiring harnesses and connectors shall be clearly identified by number and function according to the associated schematic diagrams and documentation provided by the vendor.

G. Factory Testing:

1. Before shipment of the equipment, the generator set shall be tested under rated load for performance and proper functioning of control and interfacing circuits. Tests shall include:
   a. Verification that all safety shutdowns are functioning properly
   b. Verification of single step load pickup per NFPA 110-1996, Paragraph 5-13.2.6
   c. Verification of transient and voltage dip responses and steady state voltage and speed (frequency) checks
   d. Full load test for a minimum of one hour
2. Provide complete report(s) of all testing performed

H. Startup and Checkout:

1. The supplier of the electric generating plant and associated items covered herein shall provide factory trained technicians to inspect the completed installation and perform an initial startup inspection to include:
    a. Ensuring the engine starts (both hot and cold) within the specified time
    b. Verifying that engine parameters are within specification
    c. Verifying that no load frequency and voltage adjusting is required
    d. Testing all automatic shutdowns of the generator
    e. Performing a simulation of power failure to test that generator start up and automatic transfer switches (ATS) pick up building load correctly
    f. Returning to commercial power and testing the generator and ATS to demonstrate correct cycling to normal commercial power
    g. Performing a load test of the generator, to ensure full load frequency, LP pressure and voltage is within specification by using a load bank rated at 80% of generator's capacity for a minimum of one hour
    h. Testing and verifying all remote indicators and controls
2. (VENDOR) shall provide complete report(s) of all testing performed.

6.4.1 Propane Generator

A. The prime mover shall be a liquid cooled, propane and or natural gas fueled, naturally aspirated engine of 4-cycle design.

B. The engine shall have sufficient horsepower rating to drive the generator to full output power without a gearbox between the engine and generator.

C. The engine shall have a battery charging DC alternator with a solid-state voltage regulator.

D. The alternator shall be protected by internal thermal overload protection and an automatic reset field circuit breaker.

E. One-step load acceptance shall be 100% of generator set nameplate rating and meet the requirements of NFPA 110 paragraph 5-13.2.6.

F. The electric plant shall be mounted with vibration isolators on a welded steel base that shall permit suitable mounting to any level surface.

G. A main line output circuit breaker carrying the UL mark shall be factory installed.

1. Form C auxiliary contacts rated at 250 VAC/10 amps shall be provided to allow remote sensing of breaker status.

H. Controls:

1. All engine alternator controls and instrumentation shall be designed, built, wired, tested and shock mounted in a NEMA 1 enclosure mounted to the generator set

by the manufacturer. It shall contain panel lighting, a fused DC circuit to protect the controls and a +/-5% voltage adjusting control.

2. The generator set shall contain a complete 2-wire automatic engine start-stop control, which starts the engine on closing contacts and stops the engine on opening contacts.

3. A programmable cyclic cranking limiter shall be provided to open the starting circuit after four attempts if the engine has not started within that time. Engine control modules must be solid-state plug-in type for high reliability and easy service.

4. The panel shall include:

    a. Meters to monitor

        1) AC voltage

        2) AC current

        3) AC frequency

    b. Emergency stop switch

    c. Audible alarm

    d. Programmable engine control

    e. Monitoring module

5. The programmable module shall include:

    a. Manual OFF/AUTO switch

    b. Four LED's to indicate:

        1) Not In Auto

        2) Alarm Active

        3) Generator Running

        4) Generator Ready

6. The module shall display all pertinent unit parameters including:

    a. Generator Status – ON/OFF/AUTO

    b. Instrumentation - Real-time readouts of the following engine and alternator analog values:

        1) Oil pressure

        2) Coolant temperature

        3) Fuel level (where applicable)

4) DC battery voltage

5) Run time hours

c. Alarm Status - Current alarm(s) condition of:

1) High or low AC voltage

2) High or low battery voltage

3) High or low frequency

4) Low or pre-low oil pressure

5) Low water level

6) Low water temperature

7) High and pre-high engine temperature

8) High, low and critical low fuel levels (where applicable)

9) Over crank

10) Over speed

11) Unit not in "Automatic Mode"

I. Unit Accessories:

1. Weather protective enclosure:

a. The generator set shall be factory enclosed in a heavy gauge steel enclosure constructed with 12 gauge corner posts, uprights and headers.

b. The enclosure shall be coated with electrostatically applied powder paint, baked and finished to manufacturer's specifications.

c. The enclosure is to have large, hinged doors to allow access to the engine, alternator and control panel.

2. Exhaust silencer(s) shall be provided, sized according to the manufacturer's recommendation to provide noise reduction for use in residential areas.

3. The generator set shall include an automatic dual rate battery charger manufactured by the generator set supplier. The battery charger is to be factory installed on the generator set. Due to line-voltage drop concerns, a battery charger mounted in the transfer switch will be unacceptable.

4. A heavy duty, lead acid 12 VDC battery shall be provided by the generator set manufacturer. The generator set shall have a frame suitable for mounting the

6.4.2 Automatic Transfer Switch (ATS)

A. The automatic transfer switch shall be compatible with the set to maintain system compatibility and local service responsibility for the complete emergency power system.

B. Representative production samples of the transfer switch supplied shall have demonstrated through tests the ability to withstand at least 10,000 mechanical operation cycles. The definition of one operation cycle is the electrically operated transfer from normal to emergency and back to normal.

C. Wiring must comply with NEC table 373-6(b). The manufacturer shall furnish schematic and wiring diagrams for the particular automatic transfer switch and a typical wiring diagram for the entire system.

D. Ratings and Performance:

1. The size of the ATS shall be appropriate to match the generator and shelter electrical systems.

2. The ATS shall be a 2-pole design rated for 600 VAC 200 amps continuous operation in ambient temperatures of -20 degrees Fahrenheit (-30 degrees Celsius) to +140 degrees Fahrenheit (+60 degrees Celsius).

3. The operating mechanism will be a single operating coil design, electrically operated and mechanically held in position.

4. The ATS shall be manually operable in the event of logic or electrical coil failure.

E. Controls:

1. Controls shall signal the generator set to start in the event of a power interruption.

   a. A solid-state time delay start, adjustable from 0.1 to 10 seconds, shall delay this signal to avoid nuisance startups on momentary voltage dips or power outages.

2. Controls shall transfer the load to the generator set after it reaches proper voltage.

3. Controls shall retransfer the load to the line after normal power restoration.

   a. A return to utility timer, adjustable from 1-30 minutes, shall delay this transfer to avoid short-term normal power restoration.

4. The operating power for transfer and retransfer shall be obtained from the source to which the load is being transferred.

5. Controls shall signal the generator to stop after the load retransfers to normal.

   a. A solid-state engine cool down timer, adjustable from 1-30 minutes, shall permit the engine to run unloaded to cool down before shutdown.

   b. Should the utility power fail during this time, the switch will immediately transfer back to the generator.

6. Front mounted controls shall include a selector switch to provide for a NORMAL TEST mode with full use of time delays, FAST TEST mode, which bypasses all

time delays to allow for testing the entire system in less than one minute, or AUTOMATIC mode to set the system for normal operation.

a. The controls shall provide bright lamps to indicate the transfer switch position in either UTILITY (white) or EMERGENCY (red). A third lamp will indicate STANDBY OPERATING (amber). These lights must be energized from the utility or the generator set.

b. The controls shall provide a manually operated handle to allow for manual transfer. This handle must be mounted inside the lockable enclosure and accessible only by authorized personnel.

c. The controls shall provide a safety disconnect switch to prevent load transfer and automatic engine start while performing maintenance. This switch will also be used for manual transfer switch operation.

d. The controls shall provide LED status lights to give a visual readout of the operating sequence including:

1) Utility on

2) Engine warm-up

3) Standby ready

4) Transfer to standby

5) In-phase monitor

6) Time delay neutral

7) Return to utility

8) Engine cool down

9) Engine minimum run

6.4.3 Propane Fuel System

A. (VENDOR) shall provide a complete fuel system including filled tank(s) and all associated piping, valves, controls, etc.

B. Tank and fuel system components shall be sized to provide a minimum of 72 hours of run time at full load. The fuel tank shall be a minimum 1000-gallon capacity.

C. Fuel tank(s) shall be located a minimum of 10 feet from the generator and building.

D. Clear access shall be provided for refueling.

E. Tanks shall include:

1. Steel and polyurethane construction

2. UL labeled in accordance with UL 644 and stamped in accordance with ASME Section VIII Division 1

3. Secured to an adequately sized concrete foundation
4. Protected from vehicular traffic with steal, or concrete bollards approved by King and Queen / Essex County

F. Fuel System Construction:

1. Copper pipe is unacceptable for any part of the underground fuel line system.
2. No part of fuel system shall contain bare black iron pipe.
3. Any underground steel pipe will be epoxy coated and all joints wrapped to prevent corrosion.
4. All underground pipes will be at least 18 inches below the surface.
5. Fuel lines crossing a driveway shall be installed inside a larger pipe sleeve or covered with a concrete barrier of sufficient strength to protect the lines.
6. All above ground pipe will be supported at least every 36 inches.

G. Controls and Monitoring Equipment shall include:

1. Gas capacity gauge with low fuel level alarm contact closure
2. Low fuel level monitoring device with any wires entering the shelter protected from lightning strikes.
3. Multi-valve for filling, pressure relief and gauging

6.5 Site Preparation

A. (VENDOR) shall perform all site preparation for site improvements as necessary. Work includes, but is not limited to the following:

1. Full adherence to all state and local codes
2. Protecting existing plants and grass to remain
3. Removing existing plants and grass as necessary
4. Clearing and grubbing
5. Stripping and stockpiling topsoil
6. Removing above- and below-grade site improvements
7. Disconnecting, capping or sealing, and removing site utilities
8. Temporary erosion and sedimentation control measures
9. Access road development

B. (VENDOR) or its subcontractor shall comply with Department of Environmental Resources and Bureau of Water and Soil Conservation guidelines for Erosion and Sedimentation Control.

C. (VENDOR) shall carefully examine and study existing conditions, difficulties and utilities affecting execution of work. The County will not consider later claims for additional compensation due to unanticipated labor, equipment or materials required resulting from difficulties encountered or underground water conditions.

D. (VENDOR) shall clearly identify and mark existing plant life to remain and in a manner, that insures their safety throughout construction operations.

E. Protection:

1. (VENDOR) shall protect and maintain bench mark, monument, property corner, and other reference points; reestablishing them by a registered professional surveyor if disturbed or destroyed, at no cost to King and Queen / Essex County.

2. (VENDOR) shall locate and identify existing utilities that are to remain and protect them from damage, reestablishing them if disturbed or destroyed, at no cost to King and Queen / Essex County.

3. (VENDOR) shall protect trees, plant growth and features to remain as final landscape. Branches or roots of any trees, which are to remain, shall not be disturbed. Adequate guards, fences, lighting, warning signs and similar items shall be provided and maintained as required.

4. (VENDOR) shall install protection such as fencing, boxing of tree trunks, or other measures as deemed approved by the Project Engineer.

5. (VENDOR) shall conduct operations with minimum interference to public or private accesses and facilities; maintain ingress and egress at all times; and clean or sweep any roadways daily or as required by the governing authority. At such times as deemed necessary by King and Queen / Essex County, dust control shall be provided with water sprinkling systems or equipment provided by (VENDOR) or its subcontractor.

F. Clearing:

1. (VENDOR) shall clear areas required for access to the site and execution of work.

2. Unless otherwise indicated, (VENDOR) shall remove trees, shrubs, grass, other vegetation, improvements, or obstructions interfering with the installation of new construction. Removal includes digging out stumps, roots and root material. Depressions caused by clearing and grubbing operations are to be filled to sub-grade elevation to avoid water pooling. Satisfactory fill material shall be placed in horizontal layers not exceeding 8" loose depth, and thoroughly compacted per fill requirements of this section and CSI Division 2-Site Construction-Section 02200.

3. (VENDOR) shall remove grass, trees, plant life, stumps and all other construction debris from the site to a location that is suitable for handling such material according to state laws and regulations.

G. Demolition – (VENDOR) shall remove existing pavement, utilities, curbing and shrubbery as necessary for construction of improvements.

H. Topsoil Excavation:

1. (VENDOR) shall strip topsoil from areas to be filled, excavated, landscaped or re-graded to such a depth that it prevents intermingling with underlying subsoil or questionable material.

2. (VENDOR) shall stockpile topsoil in storage piles in areas not scheduled for construction, job trailer location, or equipment lay-down areas, or where directed by the Project Engineer. Storage piles shall be constructed to freely drain surface water. Storage piles shall be covered as required to prevent windblown dust. Unsuitable soil shall be disposed of as specified for waste material, unless otherwise desired by King and Queen / Essex County. (VENDOR) or its subcontractor shall remove excess topsoil from the site.

3. Final topsoil coatings shall consist of organic soil to a depth of not less than 6". Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones and other objects over 2" in diameter, weeds, roots, and other objectionable material.

I. Access Roads:

1. A 12-foot wide access road shall be provided to the fence gate at new sites.

2. Roadbeds shall be prepared, rolled and provided with 6 inches of aggregate base course.

3. Roads shall be graded appropriately for proper drainage and minimal erosion.

6.6 Fencing

A. (VENDOR) shall provide chain-link fencing around the perimeter of all new sites.

B. Framework: Type I or Type II Steel Pipe.

1. Type I -- Schedule 40 steel pipe with 1.8 ounces of zinc coating per square foot of surface area conforming to Standard Specification ASTM (American Society for Testing and Materials) F-1 083; or,

2. Type II - Pipe manufactured from steel conforming to ASTM A569. External surface triple coated per ASTM F-1234. Type II pipe shall demonstrate the ability to resist 1,000 hours of exposure to salt spray with a maximum of 5% red rust in a test conducted in accordance with ASTM B-1 17.

3. All coatings are to be applied inside and out after welding.

4. Unless otherwise noted, Type II framework shall be provided.

5. Pipe shall be straight, true to section and conform to the following weights:

Table 1 – Type I and Type II Steel Pipe Specifications

Pipe Size Outside Diameter	Type I Weight lb.!ft.	Type II Weight lb.! ft.

1 5/8”	2.27	1.84
2”	2.72	2.28
2 W”	3.65	3.12
3”	5.79	4.64
3 W”	7.58	5.71
4”	9.11	6.56
6.58”	18.97	

C. Fabric:

1. Aluminized fabric shall be manufactured in accordance with ASTM A-491 and coated before weaving with a minimum of 0.4 ounces of aluminum per square foot of surface area. The steel wire and coating shall conform to ASTM A¬817. Fabric shall be 9-gauge woven in a 2-inch diamond mesh. The top selvage shall be twisted and barbed. The bottom selvage shall be knuckled.

2. Zinc-coated fabric shall be galvanized after weaving with a minimum 1.2 ounces of zinc per square foot of surface area and conform to ASTM A-392, Class I. Fabric shall be 9-gauge wire woven in a 2-inch diamond mesh. The top selvage shall be twisted and barbed. The bottom selvage shall be knuckled.

D. Fence Posts:

Table 2 – Fence Post Specifications

Fence Posts TYPE I - II Fabric Height	Line Post O.D.	Terminal Post O.D.
Under 6’	2”	2 W”
6’-9’	2 W”	3”
9’-12’	3”	4”

E. Gate Posts:

Table 3 – Gate Posts Specifications

Gate Posts Type II		
Single Gate Width	Double Gate Width	Post O.D. Type II
Up to 6’	Up to 12’	3 ”
7’to 12’	13’ to 25’	4 ”

F. Rails and Braces – 1 5/8" O.D.

G. Gates – Frame assembly of 2" O.D. pipe Type I or Type II with welded joints. Weld areas shall be repaired with zinc-rich coating applied per manufacturer's directions. The fence fabric shall match the fence posts, gateposts and gates. Gate accessories, hinges, latches, center stops, keepers and necessary hardware shall be of a quality required for industrial and commercial application. Latches shall permit padlocking. (VENDOR) shall provide one padlock for each gate with three keys for each padlock. All padlocks shall be keyed alike.

H. Installation:

1. General – Fence installation shall conform to ASTM F-567, Standard Practice for Installation of Chain-Link Fence.

2. Height – Fence height shall be as indicated on contract drawings. If no height is indicated, the fence shall be 7 feet high, plus 1 foot for barbed wire.

3. Post Spacing – Line posts shall be uniformly spaced between angle points at intervals not exceeding 10 feet.

4. Bracing – Gate and terminal posts shall be braced back to adjacent line posts with horizontal brace rails and diagonal truss rods

5. Top Rail – The top rail shall be installed through the line post loop caps connecting sections with sleeves to form a continuous rail between terminal posts.

6. Fencing shall have a bottom rail instead of a tension wire.

7. Fabric – The fabric shall be pulled taut with the bottom selvage 2-inches above grade. The fabric shall be fastened to the terminal posts with tension bars threaded through mesh and secured with tension bands at maximum 15-inch intervals. The fabric shall be tied to the line posts and top rails with tie wires spaced at a maximum of 12-inches on posts and 24-inches on rails. The fabric shall be attached to the bottom rail with top rings at maximum 24- inch intervals.

8. Barbed Wire – Barbed wire shall be anchored to the terminal extension arms, pulled taut and firmly installed in the slots of the line post extension arms.

9. Valleys – Should the fence cross a ditch or drainage swell, 3/8” diameter aluminum alloy rods shall be driven vertically 18” into the ground on 4-inch centers, woven through the fence fabric to provide security for these areas.

10. Vegetation-stop and aggregate shall be applied to the entire compound area (the area inside the fencing) and 6 inches beyond the fencing. Vegetation-stop shall be constructed with weed barrier geotextile and aggregate shall be applied 3 inches in depth and consist of AASHTO#1 0 coarse aggregate.

7. Training

(VENDOR) shall develop and conduct training programs to allow County personnel to become knowledgeable with the system, subsystems, and individual equipment.

7.1 General Requirements

A. (VENDOR) shall fully describe all proposed training programs detailing how (VENDOR) intends to provide training. The training description shall include the following:

1. A list of all subjects with a description of each
2. Class material to be provided by (VENDOR)
3. Number of classes
4. Class duration
5. Need for recurring training
6. Class size
7. Class cost

B. All training shall be conducted at various locations to be determined by King and Queen / Essex County. (VENDOR) shall coordinate with King and Queen / Essex County regarding number of attendees and schedule.

C. Classes shall be scheduled as near to system cutover as possible.

D. (VENDOR) shall train King and Queen / Essex County employees or designated individuals. In some cases, a Train-the-Trainer approach will be used to train other users.

E. (VENDOR) shall provide all instructional material, including printed manuals, audio, video, interactive self-paced personal computer programs, and complete equipment-operating instructions for all technical and operational training classes. Actual and or exact model and series of equipment being delivered shall be made available for hands-on use and operation during training. All instructional material shall be subject to the approval of King and Queen / Essex County and shall become property of King and Queen / Essex County.

F. Operator training classes provided by (VENDOR) shall be tailored to include actual system talk groups and subscriber/console features to be used. Standard training which covers general usage not applicable to the system provided shall be removed from the training syllabus.

7.2 Operator Training

A. (VENDOR) shall provide complete and comprehensive operational training covering features, operation, and special care associated with the equipment supplied. Operator training shall include the following categories:

1. Portable Unit Operation (structured as Train-the-Trainer)

2. Mobile Unit Operation (structured as Train-the-Trainer)
3. Dispatch Console Operation
4. Dispatch Console Supervisor

7.3 Technical/System Management Training

A. (VENDOR) shall provide complete and comprehensive technical training in the theory, maintenance, and repair of each type of equipment and system provided for the project. This training shall include, as a minimum, system theory, troubleshooting, repair, and servicing techniques as applicable to the selected system. Technical training shall include the following categories:

1. Infrastructure maintenance and troubleshooting
2. Subscriber unit maintenance and troubleshooting
3. Microwave network maintenance, and troubleshooting

B. (VENDOR) shall provide complete and comprehensive technical training for County technical staff charged with managing the system. This training shall include, but is not limited to:

1. Planning and setting up the system and network
2. Building and implementing system and network profiles and configurations
3. Performing database management functions
4. Monitoring and managing the system's performance
5. Writing and printing system reports.
6. System management training shall include the following categories:
    a. Network Management System (NMS) operation and control
    b. Fleetmapping and radio programming

8. System Implementation, Test, and Acceptance

8.1 General

A. (VENDOR) shall attend project and construction meetings as deemed necessary by King and Queen / Essex County prior to and during installation. Additional meetings may be scheduled at the discretion of King and Queen / Essex County.

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

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

8.2 Staging

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

B. Standard factory test documentation, documenting the tests performed and indicating successful completion of testing shall be submitted to King and Queen / Essex County.

C. System Staging:

1. The complete system shall be staged and tested at the factory, in the United States, to the greatest extent practical. The intent of the staging tests is to demonstrate to King and Queen / Essex County that the system is ready for shipment and installation.

2. (VENDOR) shall provide all necessary technical personnel, and test equipment to conduct staging tests. All deviations, anomalies, and test failures shall be resolved at (VENDOR)' expense.

3. (VENDOR) shall use an approved Staging Acceptance Test Plan (SATP). Expectations are that the SATP has been performed and all tests have been successful before King and Queen / Essex County witnesses the official SATP. The SATP shall be signed and dated by (VENDOR) and County representatives following completion of all tests. All tests in the SATP shall be marked as either pass, fail, or pass qualify.

4. Failed tests shall be documented, corrected, and retested. All defective components shall be replaced and the replacement component tested. Defective components that cannot be corrected shall be replaced at the expense of (VENDOR).

5. Retest of individual failed SATP tests or the entire plan shall be at King and Queen / Essex County's discretion.

6. The fully executed and completed SATP document shall be provided to King and Queen / Essex County.

8.3 System Installation

A. Installation shall include a complete, tested, system to include placement of associated cabling, appropriate system layout and terminal connections. (VENDOR) shall provide associated power supplies and any other hardware, adapters and/or connections to deliver a complete operable system to King and Queen / Essex County at the time of acceptance.

B. All installations shall be performed by factory authorized or (VENDOR) affiliated service shops. Other shops or installers may be used upon mutual agreement between King and Queen / Essex County and (VENDOR). Qualified, adequately trained personnel familiar with this type of work shall perform all installations. Vendors shall provide the names of the service shops, a summary of their experience and a list of five references (minimum) for each proposed shop.

C. Prior to the start of the system installation (VENDOR) shall participate in a mandatory project site survey with King and Queen / Essex County or the County's representative to confirm actual equipment placement within each space. At that time, (VENDOR) will determine and document the exact equipment locations.

D. (VENDOR) shall coordinate with others, as appropriate, to confirm that any prep work that affects the installation of the base station equipment, such as tower work, coring, bracing, conduit, electrical, etc., is complete before commencing the installation of any new base station equipment.

E. (VENDOR) shall provide and pay for all materials necessary for the execution and completion of all work. Unless otherwise specified, all materials incorporated into the permanent work shall be new and shall meet the requirements of this RFP. All materials furnished and work completed shall be subject to inspection by King and Queen / Essex County or King and Queen / Essex County's engineer.

F. Equipment supplied as spare equipment may not be used for installation of the proposed system. All spare equipment must be supplied in an unused condition.

G. All equipment and devices shall be cleaned internally and externally, and all damaged finishes shall be repaired.

H. Worksites shall be left neat and broom swept upon completion of work each day. All shelter floors will be thoroughly cleaned and all scuff marks and abrasions will be removed prior to acceptance. All trash shall be removed weekly.

I. Inspection:

1. King and Queen / Essex County shall conduct an inspection of the installations upon substantial completion. The County will document any deficiencies on a single punch list and provide the punch list to the Contractor for resolution.

J. Final acceptance testing shall not commence until all punch list items are resolved.

8.4 Fleetmapping

A. (VENDOR) shall develop the actual fleetmap with input and direction from King and Queen / Essex County. The fleetmap shall contain at a minimum:

1. Talkgroup ID
2. Agency
3. Emergency actions
4. Encryption capability
5. Roaming capability
6. Priority

B. (VENDOR) shall also develop subscriber programming templates for all equipment, and program the units. These templates shall have the basic features and functions defined for a particular subscriber and user type. Templates shall be developed on a per user group basis.

C. King and Queen / Essex County will be given the opportunity to test, up to 50, subscriber devices prior to cutover to ensure fleetmapping fits the needs of the users. If the fleetmapping requires modifications, (VENDOR) shall modify the fleetmap and allow for more testing by King and Queen / Essex County. There shall be no limit on the number of changes required of the fleetmapping to ensure it meets the needs of the users.

D. Once the fleetmap and templates are approved and completed (VENDOR) shall use these for installation of subscribers and for further configuration of the system. The contractor shall submit these with the final as-built documentation.

8.5 Cutover Plan

A. (VENDOR) shall be responsible for planning and coordinating the implementation of all equipment, subsystems, and the overall system.

B. Execution of the cutover plan shall ensure that new systems are brought online with minimum interruption to all existing systems and communications.

C. During detailed design review, (VENDOR) shall deliver a preliminary cutover plan describing how the radio system will be phased over into a fully-operational system:

1. (VENDOR) shall successfully complete all tests and training prior to the actual cutover of systems.
2. (VENDOR) shall provide the necessary labor to cutover from existing systems to the proposed system.
3. The plan shall include the schedule and procedures associated with the transition of each operational user group. The plan shall specifically address how the existing users will begin using the new system with minimal operational impact.
4. The plan shall provide detailed component or subsystem cutover plans, and specifically delineate between systems that affect and do not affect ongoing operations.
5. King and Queen / Essex County reserves the right to approve and change the cutover plan as it relates to any or all system components.

8.6 Cutover

A. (VENDOR) shall provide all necessary personnel required to support the Cutover Plan. These personnel will be present just prior to, during and immediately following cutover to ensure a smooth transition.

B. Cutover will not occur until all punch list items have been resolved and all installation and testing procedures have been executed and passed. King and Queen / Essex County will reserve the right to begin the cutover process in the event there are existing open punch list items.

8.7 Final Acceptance Testing

A. Prior to Final acceptance testing, (VENDOR) shall verify and document that all equipment, hardware, and software are upgraded to the latest factory revision. Multiple revision levels among similar equipment are not acceptable. King and Queen / Essex County shall receive two weeks written notice that the system is ready for final acceptance testing.

B. Final Acceptance Test Plan (FATP):

1. (VENDOR) shall use the completed and approved Final Acceptance Test Plan (FATP). Expectations are that the FATP was performed and all tests were successful before King and Queen / Essex County witnesses the official FATP. Following successful completion of the FATP, (VENDOR) and County representatives shall sign and date the FATP documentation. All tests in the FATP shall be marked as either pass, fail, or pass qualify.

2. (VENDOR) shall provide all necessary technical personnel, and test equipment to conduct FATP tests. All deviations, anomalies, and test failures shall be resolved at (VENDOR)s expense.

3. Failed tests shall be documented, corrected, and retested. All defective components shall be replaced and retested. Defective components that cannot be corrected shall be replaced at the expense of (VENDOR).

4. Retest of individual failed FATP tests or the entire plan shall be at King and Queen / Essex County's discretion.

5. (VENDOR) shall provide the fully executed and completed FATP document to King and Queen / Essex County.

8.8 Coverage Testing

A. (VENDOR) shall submit a preliminary Coverage Acceptance Test Plan (CATP) with the BAFO. The final CATP shall be submitted during the Final Design stage of the project.

B. CATP:

1. The CATP shall be consistent with the procedures and guidelines outlined in TSB-88 latest revision.

2. Coverage testing shall commence only after the radio system is fully tested and aligned. The trees must be a full foliage. Significant changes to the system will require retesting of coverage at King and Queen / Essex County's discretion.

3. (VENDOR) shall perform the following type of coverage testing:

   a. Automated objective (BER) mobile drive testing

4. Test Configurations:

   a. Testing configurations for automated and intelligibility testing shall represent typical operating configurations to the greatest extent possible, using portable and mobile radio equipment to be used with the system.

   b. Automated Objective Mobile Drive Testing:

      (VENDOR) shall test both the signal level and BER at a statistically significant number of test locations throughout the County utilizing automated test equipment.

      1) For testing purposes, the County shall be divided into 1/4- square mile bins (V2-mile x V2-mile). (VENDOR) or Contractor may subdivide grids if necessary.

      2) Inaccessible grids shall not count as either a pass or fail in the statistical analysis.

   c. Talk-out and talk-in performance shall be documented.

5. (VENDOR) shall provide a standardized test form for testing.

C. (VENDOR) shall coordinate with King and Queen / Essex County to establish pass/fail criteria as well as correlation between the subjective and objective test results.

D. Automated testing will serve as pass/fail criteria to verify system geographical coverage is 95%, at 97% reliability within the boundaries of the County. If testing fails, the coverage guarantee shall be deemed unsatisfactory. (VENDOR) shall be responsible for making necessary adjustments to system design, securing any additional equipment needed and installation of equipment and software necessary to satisfy the coverage guarantee.

E. If automated test procedures fail, (VENDOR) will re-conduct tests after correcting coverage issues.

8.9 30-Day Burn in

Upon successful completion of system acceptance testing and completion of cutover, each County will operate the system in the fully loaded configuration using normal operating parameters. Should a critical failure occur during this period (VENDOR) shall repair the system and the 30-day Burn In test will recommence for an additional 30 days. Repeating the 30- day Burn In test also restarts the system warranty start date. (VENDOR) and King and Queen / Essex County will jointly define critical failures.

8.10 As-Built Documentation

At the completion of the installation phase, (VENDOR) shall provide complete as-built documentation as outlined below:

A. Equipment provided

B. Plan and elevation drawings of all equipment including antennas on towers

C. Cabling and terminations

D. Block and level diagrams

E. Site layout drawings

F. Tower mapping documentation

G. Tower structural analysis documentation

H. Detailed design documentation

I. Fleetmapping and programming

J. Setup and alignment information

K. Successfully completed, signed, and dated acceptance testing documents including staging, coverage and final acceptance testing.

L. Warranty documentation

8.11 System Acceptance

King and Queen / Essex County shall deem the system ready for System Acceptance following successful completion and approval of the following:

A. System testing

B. Cutover

C. RF Coverage testing

Following system acceptance, the warranty/maintenance period will start, as well as the 30-day burn-in.

8.12 Final System Acceptance

King and Queen / Essex County shall deem the system ready for final system acceptance following successful completion and approval of the following:

A. Final Design submittals

B. Staging Acceptance Test Plan (SATP)

C. System installation

D. Final inspection and punch list resolution

E. As-built documentation

F. Final Acceptance Test Plan (FATP), including Coverage Acceptance Test Plan (CATP)

G. Thirty day operational test completion

H. Training

9. Warranty, Maintenance, and Support

9.1 Warranty

A. The proposed communications system shall have a warranty and maintenance period of 3 years. The warranty/maintenance period shall commence upon System Acceptance.

B. (VENDOR) shall provide a single toll-free telephone number that answers 24 hours a day, seven days a week, 365 day a year, for service requests and warranty claims.

C. (VENDOR) shall state in the BAFO the name, address, and capabilities of the service station(s) providing warranty service.

D. The following procedures shall be followed during the warranty period:

1. Warranty Maintenance shall be performed 24 hours a day at no additional charge to the County.

2. The service facility shall provide prompt repair service, with service personnel arriving onsite within 2 hours after a service request by King and Queen / Essex County and returning the system to service within 4 hours after a service request by King and Queen / Essex County.

3. King and Queen / Essex County shall receive written documentation indicating the cause of the service outage, the resolution, and all post-repair testing procedures to ensure proper operation. In the event a repair requires the use of County owned spares, the documentation shall note the model and serial number of both the defective unit and the spare. Spare equipment will be repaired or replaced and returned to the spares inventory. (VENDOR) may not substitute a rebuilt unit for a defective new unit. The original unit must be repaired and returned or be replaced with a factory new unit.

4. For all equipment needing factory or depot repairs, (VENDOR) shall put in place a comprehensive tracking system to track units to and from the factory/depot.

E. The following services will be provided during the warranty period:

1. Network Monitoring – (VENDOR) shall remotely monitor all components provided as part of this procurement. Monitoring shall be performed 24 hours a day 7 days a week from a remote location specifically staffed with personnel performing monitoring duties for other systems throughout the United States. (VENDOR) shall provide and pay for all connectivity required for network monitoring. (VENDOR) shall log all network monitored events and provide a report to King and Queen / Essex County on an agreed upon schedule.

2. Dispatch Services – (VENDOR) shall notify the appropriate personnel in the event of a system event detected through the network monitoring service. Any events requiring notification of maintenance personnel shall be logged and provided to King and Queen / Essex County on a monthly basis, or as requested.

3. On-Site Repair, (VENDOR) shall supply the appropriate personnel to provide on-site repair of any failed system components or ancillary equipment. (VENDOR) or

its subcontractors shall perform all necessary repairs to all components provided through this procurement. System components shall be returned to a fully functional state via direct on-site repair, replacement of faulty module, or replacement of the entire component.

4. Depot Repair – (VENDOR) shall provide for depot repair of any faulty components found to be defective, or that are not within factory specifications.

5. Software Upgrade – (VENDOR) shall install all software updates that have been released and are applicable to the provided system and its components. All labor and software shall be provided by (VENDOR). Prior to expiration of the warranty period, all system software shall be upgraded to the latest software revision shipping on the end of warranty date. County owned spare parts shall be included in software upgrade process.

6. Hardware Upgrade – Should the software upgrade require it, (VENDOR) shall upgrade any hardware that is not compatible with the latest revision software.

7. System Manager – (VENDOR) shall provide system management functions by an individual that has been factory trained and is competent to monitor and change network settings as required by King and Queen / Essex County. These services shall be available during the system warranty period on an as needed basis and will not be limited to alias database changes, usage and alarm reports. If the system manager provided by (VENDOR) is unable to perform any changes to the system, (VENDOR) shall provide the appropriate personnel to meet the request of King and Queen / Essex County.

8. Spare parts, (VENDOR) shall maintain a sufficient quantity of spare parts to maintain 24/7 operation of the provided system and subsystems. As an OPTION King and Queen / Essex County may purchase spare parts.

9.2 Maintenance

(VENDOR) shall maintain and repair all systems, equipment, hardware and software throughout the implementation, migration and warranty periods. King and Queen / Essex County reserves the right to have technical staff onsite to witness, and if desired, assist in the maintenance and troubleshooting procedures. This does not relieve (VENDOR) from warranty and maintenance responsibility as defined in this request for BAFO.

9.2.1 General Requirements

A. Comprehensive maintenance services shall be proposed for each system, including both preventive and corrective maintenance.

B. (VENDOR) shall provide a list of maintenance plans available. Plans should be based on the quantities of equipment included in the proposed system. Plans should have options for 1, 2, or 3 years. These plans shall include:

1. Subscriber unit repair

2. Fixed equipment onsite service

a. 2-hour response time

b. 4-hour response time

c. 8-hour response time

d. Next day response time

e. Full time onsite technician

3. Fixed equipment mail-in board repair;

   a. Normal response - 7 day

   b. Emergency response - Next day

4. All fixed equipment maintenance plans shall provide 24-hour system support where users can dial one toll-free number to report problems and/or receive technical support.

5. For fixed onsite maintenance, (VENDOR)' staff will then dispatch the proper technician in the prescribed response time to resolve a problem, if (VENDOR) is unable to resolve the problem through telephone consultation.

9.2.2 Maintenance Standards

A. Replacement parts used in repairs shall be equal in quality and ratings to the original parts.

B. Equipment shall be maintained in a clean condition. Oil, dust and other foreign substances shall be removed on a routine basis.

C. Equipment and system performance shall be maintained at the level initially described in these equipment and systems specifications. The service organization shall maintain records to confirm this has been done at intervals defined by King and Queen / Essex County.

D. (VENDOR) shall provide only factory trained and authorized maintenance personnel.

E. If fixed equipment or a fixed equipment module fails more than twice during the acceptance test or twice during the first year after system acceptance, (VENDOR) shall meet with King and Queen / Essex County to discuss and explain such failures. If, in the opinion of King and Queen / Essex County, these failures indicate that the equipment is potentially prone to continuing failures, (VENDOR) shall replace it at no cost to King and Queen / Essex County.

9.3 Parts Availability

A. From the date of final acceptance to the seventh anniversary of the date of final acceptance, (VENDOR) shall maintain replacement parts for all delivered equipment.

B. In the event (VENDOR) plans to discontinue stocking any part required for maintenance after the seventh anniversary of acceptance, (VENDOR) shall send written notice to the

County 24 months prior to the date of discontinuance to allow for last-time buys and replenishment.

C. All parts, ordered on a priority basis, shall be delivered within 24 hours after placing an order. (VENDOR) shall provide year around, 24-hour ordering facilities via telephone, internet, e-mail, and fax service.

9.4 Spare Equipment

A. (VENDOR) shall propose to King and Queen / Essex County as an OPTION, recommended spare parts for the system, subsystems, and individual equipment.

B. The list of spare parts shall include, but is not limited to:

1. Any vendor identified Field Replaceable Units (FRUs)
2. Any infrastructure component, which does not have FRUs that can cause critical failure if it were to fail. Examples could include Base Station Antennas and other non-modular components.
3. Power supplies
4. Test measurement, calibration and repair kits
5. Diagnostic equipment to support County maintenance activities
6. Spares for less critical items shall also be enumerated

C. The list shall include items that will rapidly and completely restore all critical system functionality with the least amount of effort, e.g., board replacement instead of troubleshooting to the component level when a critical unit has failed.

D. The quantities of spares in the list shall be appropriately sized to accommodate equipment quantities in the system.

E. The list shall define the primary equipment category each spare kit supports, e.g., transceiver board for a repeater, interface board for a console, etc.

F. The system engineering design documentation shall include a narrative on (VENDOR)' ability to replace failed units from stock and the process and timing to repair, replace, and return failed units delivered for repair.

G. System engineering design documentation shall also include the life cycle of equipment, parts, and other maintenance support for the system.

9.5 Post Warranty Maintenance

A. As an OPTION, (VENDOR) shall propose maintenance services for subsequent years, renewable on an annual basis. A minimum of pricing for years 4 through 10 shall be provided.

B. (VENDOR) shall fully describe the terms and conditions of the extended warranty in the BAFO.

C. (VENDOR) shall indicate who the local authorized repair facility will be for post warranty repairs upon completion of the Detailed Design Review process.

D. Pricing shall include at a minimum all services provided during the warranty period. Scope of Work (SOW) documents shall be provided for all proposed services. In the event the (VENDOR) wraps several services into a larger offering those services shall be broken in each service and SOW documents provided.

10. County Terms and Conditions

Glossary of Terms and Acronyms

AC	Alternating Current
AE/LZT-123 4618/1	(VENDOR) standards for site grounding and lightning protection
AES	Advanced Encryption Standard
AGC	Automatic gain control
Agency	Term that applies generically to any local, state, federal entity or organization, such as; a department, division, County/town, or bureau. Includes government, quasi-government and private groups.
ANS	American National Standard
ANSI	American National Standards Institute
APCO	Association of Public-Safety Communications Officials International
ASTM	American Society for Testing Materials
ATS	Automatic Transfer Switch
backhaul	The transporting of radio communications traffic between distributed sites (typically access points) and more centralized points of presence.
BAFO	Best and Final Offer
BER	Bit Error Rate – A measure of the number of errors in received transmissions when compared to the original transmission, frequently expressed as a percentage.
BTU	British Thermal Unit
CAD	Computer Aided Dispatch
CAI	Common Air Interfaces
CATP	Coverage Acceptance Test Plan
channel	The route through which a message is sent. A connection between initiating and terminating nodes of a circuit. A single path provided by a transmission medium via an electrical separation, such as by frequency or frequency pairs.
communications	Information transfer among or between users. In public safety communications, the ability of public safety agencies to talk across agencies.
connectivity	The complete path between two terminals.
conventional	A radio system with dedicated, single-purpose channels (can be shared between several users with different operational needs; e.g., fire and police). A user must select the specific channel to use.
coverage	The geographic area included within the range of a wireless radio system.

DAQ	Delivered Audio Quality
dB	Decibel
DC	Direct Current
DCM	Digital Content Manager
DCP	Distributed Computing Platform
DCPF	A network management protocol
digital	Radio transmission method that replaces analog systems and transmits its signal in binary 1's and 0's the same as a computer. One major difference is that digital signals do not degrade gradually the way analog does as the distance between the transmitter and receiver increases.
EIA	Electronic Industries Alliance (publisher of standards)
EM I/RFI	Electromagnetic Interference/Radio Frequency Interference
EMS	Element Management Systems
encryption	The reversible transformation of data from the original (plain text) format to a difficult to interpret format as a mechanism for protecting its confidentiality, integrity and sometimes its authenticity. Encryption uses an encryption algorithm and one or more encryption keys.
FAA	Federal Aviation Administration
FATP	Factory Acceptance Test Plan
FATP	Final Acceptance Test Plan
FCC	Federal Communications Commission
FDMA	Frequency Division Multiple Access
first responders	The first professionals called to an incident or emergency who provide immediate support services during prevention, response, and recovery operations.
FM	Frequency modulation; a signal transmission with constant signal strength, where the center frequency varies in proportion to the voice being transmitted. FM signals are not susceptible to most interference sources. Radio systems operating on FM are being replaced by digital systems.
frequency	The number of cycles or events of a periodic process in a unit of time.
frequency bands	The spectrum of transmission space where mobile radio systems operate in the United States. They are (from low to high): High HF 25-29.99 MHz Low VHF 30-50 MHz High VHF 150-1 74 MHz

	Low UHF 450-470 MHz
	UHF TV Sharing 470-512 MHz 700 MHz 764-776 & 7940806 MHz 800 MHz 806-869 MHz
	2.4 GHz
	4.9 GHz
FRU	Field Replaceable Units
Gateway	A device that can transparently interconnect radio audio paths so that agencies can patch into each other's radio channels in real time. This can be done at the baseband level or using IP. A gateway provides interconnection between two networks with different communications protocols.
GFI	Ground Fault Interrupter
GHz	gigahertz (1 billion hertz)
GoS	Grade of Service
GPS	Global Positioning System, a U.S. satellite system that lets persons or systems determine their position with extreme accuracy using GPS receivers.
GUI	Graphical User Interface
HVAC	Heating Ventilation and Air Conditioning
Hz	Hertz (same as cycles per second)
ID	Identification
IEEE	Institute of Electrical and Electronic Engineers
infrastructure	Dedicated telecommunications networks; the hardware and software needed to complete and maintain a public safety communications system
interference	Extraneous energy, from natural or man-made sources, that impedes the reception of desired RF signals.
interoperability	The ability of diverse systems and organizations to work together (inter-operate). In public safety, the ability of personnel to exchange voice and data communications with staff from other agencies, on demand and in real time.
IP	Internet Protocol
ISSI	Inter-RF Subsystem Interface
kHz	kilo Hertz (1000 Hertz)
kW	Kilowatts
LCD	Liquid crystal display
LMR	Land Mobile Radio – A public or private radio service providing two-way communication, service paging and radio signaling on land.

Mbps	Mega bit per second (1 million bits per second)
MHSB	Monitored Hot Standby
MHz	Megahertz (1,000,000 Hz)
modem	An acronym for modulator/demodulator, which is a device that translates digital signals coming from a computer into analog signals that can be transmitted over standard telephone lines. The modem also translates the analog signals back into digital signals that a computer can understand.
MPE	Maximum Permissible Exposure
ms	milliseconds
mutual aid	Generally describes a situation where a major emergency or incident requires a large number of agencies, including agencies from remote locations, working together to mitigate the crisis.
mutual aid channel	A radio channel specifically allocated for use during emergency mutual aid situations.
NAS	Network Attach Storage
NEC	National Electric Code
NEMA	National Emergency Management Association
NFPA	National Fire Protection Association
NiMH	Nickel-Metal Hydride
NMS	Network Management System
NMT	Network Management Terminals
OET	Office of Engineering Technology
OSHA	Occupational Safety and Health Administration
OTAP	Over-the-Air Programming
OTAR	Over-the-Air Rekeying
Project 25 (P25) or APCO-25	A suite of standards for digital radio communications for use by federal, state/province and local public safety agencies in North America to enable them to communicate with other agencies and mutual aid response teams in emergencies.
PTT	Push-to-Talk
QA/QC	Quality Assurance/Quality Control
RAID	Redundant Array of Independent Discs
receiver	The component(s) of a radio device that converts the radio waves into audible signals.

repeater	A special receiver/transmitter combination that receives a signal on one frequency and retransmits a new signal on another frequency, usually within the same frequency band, sometimes referred to as a relay station.
RF	Radio Frequency
RTU	Remote Terminal Unit
SATP	Staging Acceptance Test Plan
SHPO	State Historic Preservation Office
SNMP	Simple Network Management Protocol
spectrum	The range of electromagnetic radio frequencies that can be decomposed into frequency components, used in the transmission of sound, data and television.
subscriber	User, customer on a network.
subscriber unit	User's equipment (usually a mobile or portable radio).
SWR	Standing Wave Ratio
talkgroup	Radio system users assigned to a specific group of users who regularly communicate with each other.
TCP	Transmission Control Protocol
TDMA	Time-division multiple access
TDMM	Telecom Distribution Methods Manual
TIA	Telecommunications Industry Association
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
TTA	Tower Top amplifiers
trunked	A radio system with a group of channels available and assigned as needed to specific "groups" or operations. The channels are programmed for automatic system assignment while in-use, and then released for other users. A trunked system maximizes channel utilization.
turnkey	Entire system with hardware and software assembled and installed by a vendor and sold as a package.
TVSS	Transient Voltage Surge Suppression
UHF	Ultra High Frequency
UL	Underwriters Laboratory
UPS	Uninterruptible Power Supply
USGS	U.S. Geological Survey
VAC	Volts Alternating Current

VDC	Volts Direct Current
VHF	Very High Frequency
WBS	Work Breakdown Structure

Appendix A - Compliance Matrix

(VENDOR) must complete this Compliance Matrix and submit along with its Best and Final Offer.

RFP Section	Description	(VENDOR)' Statement of Compliance	(VENDOR)' Clarifications and Comments
1	PROJECT OVERVIEW		
1.1	Introduction		
1.2	Overview of this Document		
1.3	Project Summary		
1.4	Response Desired		
1.4.1	Standards and Guidelines		
1.4.2	Frequency Coordination and Licensing		
1.4.3	Federal Aviation Administration (if Applicable)		
1.4.4	Project Management		
1.4.5	QA/QC Program		
1.5	BAFO Response Format		
1.6	Evaluation		

RFP Section	Description	(VENDOR)' Statement of Compliance	(VENDOR)' Clarifications and Comments
1.7	Award of Contract		
1.8	Detailed Design (60 calendar days after contract award)		
1.9	Detailed Design Review (60 calendar days after contract award)		
1.10	System Shipping/Delivery		
2	Radio Communications System Requirements		
2.1	Overview		
2.2	Project 25, Phase 2		
2.3	Redundancy and Survivability		
2.4	Expansion		
2.5	Site Selection		
2.6	Coverage		
2.6.1	Coverage Model and Maps		
2.6.2	Link Budgets		
3	RADIO COMMUNICATIONS SYSTEM DESIRED		

RFP Section	Description	(VENDOR)' Statement of Compliance	(VENDOR)' Clarifications and Comments
3.1	Overview		
3.2	System Control Equipment		
3.3	Simulcast Equipment		
3.4	Receiver Voting		
3.5	Base Station Equipment		
3.6	Antenna Systems		
3.7	Gateway Devices		
3.8	Site DC Power		
3.9	Dispatch Console Subsystem		
3.9.1	General Requirements and Features		
3.9.2	Trunked Requirements		
3.9.3	Conventional Requirements		
3.9.4	Operator Position Equipment		
3.9.5	Console Networking Equipment		

RFP Section	Description	(VENDOR)' Statement of Compliance	(VENDOR)' Clarifications and Comments
3.9.6	Console Backup System		
3.10	Voice Logger Recorder		
3.11	Network Management Subsystem (NMS)		
3.11.1	Network management Terminals (NMT)		
3.11.2	Remote Terminal Units (RTU)		
4	BACKHAUL NETWORK		
4.1	Digital Microwave Network		
4.2	Microwave Backhaul Network Engineering		
4.3	Microwave Antenna System		
4.4	Microwave Backhaul Network Management		
5	SUBSCRIBER EQUIPMENT		
5.1	Overview		
5.2	General Requirements		
5.2.1	Portable Radios		

RFP Section	Description	(VENDOR)' Statement of Compliance	(VENDOR)' Clarifications and Comments
5.2.2	Mobile Radios/Control Stations		
6	FACILITIES AND INFRASTRUCTURE DEVELOPMENT		
6.1	General		
6.2	Towers		
6.3	Shelters		
6.4	Generator and Automatic Transfer Switch (ATS)		
6.4.1	Propane Generator		
6.4.2	Automatic Transfer Switch (ATS)		
6.4.3	Propane Fuel System		
6.5	Site Preparation		
6.6	Fencing		
7	TRAINING		
7.1	General Requirements		
7.2	Operator Training		

RFP Section	Description	(VENDOR)' Statement of Compliance	(VENDOR)' Clarifications and Comments
7.3	Technical/System Management Training		
8	SYSTEM IMPLMENTATION, TEST AND ACCEPTANCE		
8.1	General		
8.2	Staging		
8.3	System Installation		
8.4	Fleetmapping		
8.5	Cutover Plan		
8.6	Cutover		
8.7	Final Acceptance Testing		
8.8	Coverage Testing		
8.9	30-Day Burn-in Test		
8.10	As-Built Documentation		
8.11	System Acceptance		
8.12	Final System Acceptance		

RFP Section	Description	(VENDOR)' Statement of Compliance	(VENDOR)' Clarifications and Comments
9	Warranty, Maintenance and Support		
9.1	Warranty		
9.2	Maintenance		
9.2.1	General Requirements		
9.2.2	Maintenance Standards		
9.3	Parts Availability		
9.4	Spare Equipment		
9.5	Post Warranty Maintenance		
10	City/County Terms and Conditions		
Appendix A	Compliance Matrix		
Appendix B	BAFO Pricing Forms		

Appendix B - BAFO Pricing Forms

Table B.1 – BAFO Pricing Summary Sheet (Total Cost)

(VENDOR) Shall complete all forms	
System Components	Total
System Control Equipment	
Remote Site Equipment	
Dispatch Console Equipment	
Microwave Network	
Spare Equipment	
Other	
Total Infrastructure	
Services	Total
Installation	
Project Management	
System Engineering	
System Staging	
Coverage and Acceptance Testing	
Documentation	
Training	
Warranty & Maintenance	
Other	
Total Services	
Infrastructure Development Cost (Table B-4)	
Phase II Upgrade (to 6.25 kHz Bandwidth)	
Total BAFO Cost	

Appendix C - Fire Paging

The vendor will provide and install in each locality a separate VHF analog repeater at each of the 450 MHz system sites in Essex County to provide fire paging and interoperability with surrounding agencies. The VHF system will be simulcast and will be connected to the consoles. The consoles will provide the appropriate tone signaling to be transmitted to the pagers for activation. The consoles will also provide the appropriate patching capabilities to allow a patch between the VHF simulcast system and the 450 MHz P25 system in both counties.

Appendix D – UHF Interoperability

The vendor will provide and install a UHF analog repeater at one site in each county of the 450 MHz system sites to provide interoperability with surrounding agencies on the Non Federal Interoperability Channels subject to FCC licensure on the calling channel and one tactical channel. The UHF analog repeater will be connected to the consoles and capable of independent function. The consoles will also provide the appropriate patching capabilities to allow a patch between the UHF analog simulcast system and the 450 MHz P25 system. Referred to as UCALL 40 453/458.2125 and at least one of the UTAC channels- such as UTAC 41 453/458.4625

Appendix E – VHF Base station /Statewide EMS Interoperability

The vendor will provide and install a VHF analog base station at one site in each county operating on the 155.205 MHz subject to FCC licensure, at a location identified within the system to best optimize the system to provide mobile and aircraft interoperability with surrounding agencies on Virginia EMS Interoperability Channel. The VHF system will be simplex and will be connected to a talk group in the system. The consoles will also provide the appropriate patching capabilities to allow a patch between the VHF analog base system and the 450 MHz P25 system.

Appendix F – VHF Low Interoperability

The vendor will provide and install a VHF Low band analog base station at one site in Essex county operating on the 39.54 MHz subject to FCC licensure, at a location identified within the system to best optimize the system to provide mobile interoperability with surrounding agencies on the Virginia Statewide SIRS Interoperability Channel. The existing King and Queen SIRS repeater will be integrated to the new system. The UHF system will be simplex and will be connected to the consoles. The consoles will also provide the appropriate patching capabilities to allow a patch between the VHF Low analog simulcast system and the 450 MHz P25 system.

Appendix G – Control Stations - Identified

As part of the gateway and control station section, the vendor will provide connectivity option(s) for control stations to access the King William, Caroline, and Gloucester county 700/800 MHZ Motorola Trunked radio systems, The Richmond County VHF IDAS radios system, and the proposed Middlesex County 700 (VENDOR) radio system

Appendix H – 700 Interoperability OPTION

The vendor will provide and install a 700 MHZ simulcast overlay at each of the sites in each county of the 450 MHz system sites to provide interoperability with surrounding agencies on the Non Federal Interoperability Channels subject to FCC licensure on the calling channel and one tactical channel. The 700 MHz network repeater will be connected to the consoles and capable of independent function. The consoles will also provide the appropriate patching capabilities to allow a patch between the 700 simulcast system and the 450 MHz P25 system.